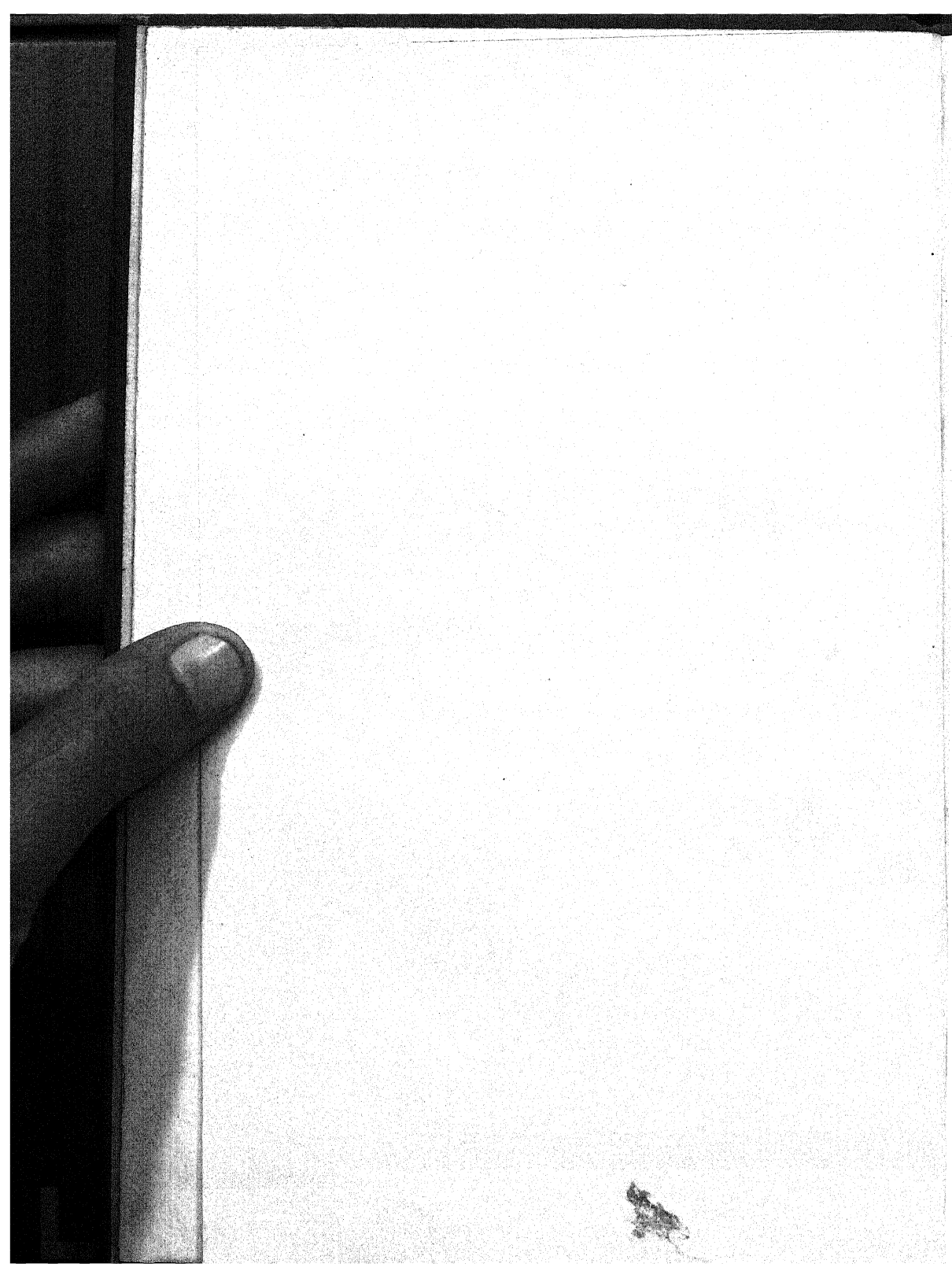




GEORGE HALL CONKLIN (1866-1940)







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## GEORGE HALL CONKLIN (1866-1940)

Dr. Conklin passed away March 10, 1940 at St. Mary's Hospital, Superior, Wisconsin, after a brief illness.

He was born at Battle Creek, Michigan, on June 13, 1866. At an early age he decided to become a physician and graduated from the Department of Medicine and Surgery at the University of Michigan in 1888. During his stay at the University he became affiliated with Theta Delta Chi social fraternity, and throughout his later years was always keenly interested in the progress and development of the fraternity. The year after graduation was spent in post-graduate work in this same institution, and he went directly to Superior, Wisconsin, to begin the practice of medicine. For several years, during those early days of horse and buggy, sleigh, or even snowshoes, when the going was particularly rough, he held the position of County Physician for Douglas County. He continued in general practice until 1917, when, soon after the United States entered the war, he volunteered and became a member of a medical replacement unit.

Dr. Conklin was commissioned a Major while at Base Hospital No. 1, Vichy, France, and after the Armistice was assigned to duty at Gondrecour, Germany. After the war he took post-graduate work at Chicago University, specializing in pediatrics and on his return to Superior took up the cause of medical aid for underprivileged children, where for several years, in coöperation with others he conducted the free baby-clinics. In 1929 he became a full-time directing physician of the City Health Department, in which office he did much to improve the health of the

community through milk supervision and improved sanitation. After four years in this position he was chosen to take charge of the new County Tubercular Sanitorium (Middle River) at Hawthorne, which, through his untiring efforts, became one of the most effective of its kind in the state. In recognition of this service and in appreciation of his devotion to the betterment of life for the citizens of Superior, his friends have organized a Doctor Conklin Memorial Fund, to be used in supplying a microscope and other much needed equipment to extend further the important general rehabilitation program of vocational classes for convalescing patients at the Sanitorium, a project in which Dr. Conklin was deeply interested. He married Edith L. Sheffield, who died in 1917. His only child, a daughter, Mrs. Adona M. Fuller of Amesbury, Mass., died in 1929.

Throughout his life he was particularly interested in young people and seemed to have the great gift of being able to interest them in the various lines of nature study. He received the Beaver Award from the Boy Scouts, a just honor to one who had served them for a long time.

Dr. Conklin was interested in all things botanical, and was very thorough in his studies of the various groups of plants with which he worked. He became the 186th member of the Sullivant Moss Society in 1908, and the next year took over the work of Miss Caroline C. Haynes as Head of the Hepatic Department and its Herbarium, a post which he held until 1932 when illness and the pressure of other duties forced him to give up this work in which he was so interested and in which he found so much enjoyment. During this time, under his supervision, the Herbarium grew from 1,896 to 10,475 specimens. In addition, he determined innumerable specimens for beginners and all who had trouble with "difficult specimens," and also found the time to prepare many hundreds of packets which were distributed to the members as exchanges.

Not only his untiring efforts in answering the countless questions and requests which came to him from the members of the Society but also his charming personality, friendly counsel and encouragement, particularly to those of us who were beginners, have endeared him to all of us. The Sullivant Moss Society has suffered a great loss in his passing. Dr. Conklin, while not one

of the founders, was one of the *builders* of the organization, and it is to him and his efforts that we owe a lasting debt for the large, well organized Hepatic Department for which he worked so tirelessly. He has made many friends for the Society both in this country and abroad and his death is deeply felt by all.

Dr. Conklin has contributed several valuable papers on hepatics, among them a treatment of the hepatics of Wisconsin, and at the time of his death had in preparation a list of the hepatics of Minnesota. By the terms of his will he has left to the Hepatic Department of the Sullivant Moss Society his bound set of *THE BRYOLOGIST*, some 40 volumes of papers and books on the Hepaticae, collected over a long period of years, an index which he had prepared, and his collection of hepatics. All of these will be moved to the University of Cincinnati to be housed with the Hepatic Herbarium.—MARGARET FULFORD, Curator of Hepaticae, UNIVERSITY OF CINCINNATI.

#### BRYOLOGICAL PAPERS BY GEORGE H. CONKLIN

Brief notes on the distribution of Hepaticae. *THE BRYOLOGIST* **15**: 11–12. 1912.

Hepaticae of the sixth edition of Gray's Manual compared with the Exchange List. *THE BRYOLOGIST* **15**: 88–91. 1912.

Preliminary Report on a collection of Hepaticae from the Duluth-Superior District (Minn. & Wisc.). *Trans. Wisc. Acad. Sci., Arts, and Letters* **17**: 985–1010. 1914.

A list of Hepaticae collected upon Isle Royale, Lake Superior. *THE BRYOLOGIST* **17**: 46–48, 52–55. 1914.

Hepatic Note. *THE BRYOLOGIST* **18**: 23. 1915.

Sullivant Moss Society, report of the Hepatic Department for 1916. *THE BRYOLOGIST* **20**: 13–14. 1917.

(List of French Hepaticae collected by Major George H. Conklin, M.R.C. by Caroline C. Haynes. *THE BRYOLOGIST* **22**: 27. 1 pl. 1919.)

The Hepaticae of Wisconsin. *Trans. Wisc. Acad. Sci., Arts, and Letters* **24**: 197–247. 1929.

Report of the Curator of the Hepatic Department for 1921. *THE BRYOLOGIST* **25**: 23. 1922.

Report of the Curator of the Hepatic Herbarium. *THE BRYOLOGIST* **26**: 10–11. 1923.

Report of the Curator of the Hepatic Herbarium of the Sullivant Moss Society for 1924. *THE BRYOLOGIST* **28**: 13–14. 1925.

Report of the Curator of the Hepatic Department of the Sullivant Moss Society for 1925. *THE BRYOLOGIST* **29**: 15–16. 1926.

Collecting Hepatics along Lake Superior in northern Minnesota.

THE BRYOLOGIST **30**: 6-8. 1927.

Report of the Curator of the Hepatic Department of the Sullivant Moss Society for 1926. THE BRYOLOGIST **30**: 13-14. 1927.

A correction, with additions. THE BRYOLOGIST **31**: 33. 1928. Report of the Department of Hepatics for the years 1929 and 1930.

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Hepaticae of Minnesota. (In press.) 1941.

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### AN APPRECIATION OF THE WORK OF LELLEN STERLING CHENEY<sup>1</sup>

Although we had corresponded through the years, I had only one visit with Mr. Cheney, when he called one day about ten years ago. After dinner we sat and visited until long after midnight, he recalling the incidents of his early collecting trips. He had a fine memory and could recall vividly the conditions and many times remember the localities where he had found certain specimens. He had a fund of experiences, and his whimsical anecdotes were a delight to listeners. The next day we rode out to Manitou Falls of the Black River, in Douglas County, and he was much impressed with the possibility of finding mosses at this locality new to him. His intent was to come to camp and collect the following year, but his work took him to the southern part of the state, to my great regret.

During the years he was connected with the Department of Plant Pathology, he continued his pioneer collections of bryophytes in the southwest counties of the state, very little escaping his keen eyes and broad botanical interest. It was during these early years at the University that he began the first botanical surveys of Wisconsin which made him well known in the botanical world. His contributions to the knowledge of Wisconsin plant life have been recognized as very important ones, since he was Wisconsin's pioneer collector and taxonomist.

When he entered the State University of Wisconsin in 1889 as a student, later to become instructor and associate professor of botany, he was well fitted, physically and mentally, for those

<sup>1</sup> Notes prepared by Dr. George Hall Conklin shortly before his own death, March 10, 1940, and communicated by Dr. Richard I. Evans, University of Wisconsin, who is revising and completing Mr. Cheney's Catalogue of Wisconsin Mosses—W. C. S.

early general botanical surveys undertaken by the University between 1891 and 1897. The material which he and his associates collected laid the foundation for the University Herbarium, stimulated later research in specific plant groups, and formed the basis of reports in subsequent years on the flora of Wisconsin.

In 1893 he published, in collaboration with Professor R. H. True, "On the flora of Madison and vicinity," a report which lists seven hundred and twenty-nine species of flowering plants, one hundred and thirty-five mosses, and fifteen liverworts from some five thousand specimens examined.

In the summer of 1891, through the kindness of Mr. F. F. Foot, Mr. Cheney made an extended canoe trip to northern Minnesota, the Lake Superior region, and the International Boundary. Mr. Cheney gives the following description in one of his reports: "Collecting was done at Fond du Lac on the St. Louis River; along the lake shore from Grand Marais to Grand Portage; along the old Dawson canoe route from Grand Portage to Basswood Lake; from this lake along the canoe route commonly traveled to Ely and Tower."

"Work was begun June 16th at Fond du Lac. We were detained ten days at Grand Marais awaiting the construction of a canoe. At Rove Lake we were obliged to wait four days for provisions. With these two exceptions we never stopped longer than thirty-six hours at a place. We generally travelled ten to twelve miles each day, collecting on the way. We reached Tower, Minn. August 3rd."

Two years later, in 1893, he published "A contribution to the Flora of the Lake Superior Region," in which two hundred and twenty-four species of flowering plants, nine ferns and fern allies, ninety-seven mosses, and fifteen hepatics are listed.

In the summer of 1893, from June 9th to August 6th, Mr. Cheney began a botanical survey of the upper Wisconsin River valley. Starting from Lac Vieux Desert, he followed the Wisconsin River to Wausau, collecting afoot on shore while the boat carried supplies and camping outfit. Similar surveys were continued from 1894 through 1897 and included trips to the northern watershed along the principal river routes. Collections were made at Drummond on the White River, Ashland County; Montreal River, Iron County; and along the shore of Lake



Superior at Ashland, Bayfield, Oak and LaPresque Isles, Cornucopia, Herbster, and Superior.

This area was sparsely settled and much of it was covered with virgin forests, its waterfalls, cascades, rapids, and moss-covered ledges unimpaired by man. The collections made during those years were extensive, of both flowering plants and bryophytes, but unfortunately only a few reports were made on them. One hundred and twenty-five selected specimens of hepatics were sent to Dr. L. M. Underwood for identification, from which thirty-five species were reported in 1894, at which time the *Sphagna* were also reported. It was not until thirty-six years later that the remaining specimens of hepatics were released, identified, and published<sup>1</sup> in "The Hepaticae of Wisconsin."

Later in life, Mr. Cheney's interest again centered on bryology, and he published several articles in THE BRYOLOGIST. At the time of his death, April 10, 1938, he was seriously occupied with the preparation of a catalogue of Wisconsin mosses.

#### BRYOLOGICAL PAPERS BY L. S. CHENEY

A contribution to the flora of the Lake Superior Region. Trans. Wis. Acad. Sci., Arts & Lett. **9**: 233-254. 1893. (A joint paper with R. H. True.)

*Sphagna* of the Upper Wisconsin Valley. Trans. Wis. Acad. Sci., Arts & Lett. **10**: 66-68. 1894.

Hepaticae of the Wisconsin Valley. Trans. Wis. Acad. Sci., Arts & Lett. **10**: 70-72. 1894.

Fruiting *Eustichia norvegica* Brid. Bot. Gaz. **19**: 384. 1894.

*Eustichia norvegica* in fruit. Rev. Bryol. **21**: 76-77. 1894.

North American species of *Amblystegium*. Bot. Gaz. **24**: 236-291. 1897.

An historical review of the work done on the flora of the territory now included within the limits of Wisconsin. Pharmaceutical Review **18**: 557-565; **19**: 2-15. 1900-1901.

Notes on interesting Wisconsin mosses. THE BRYOLOGIST **30**: 104-105. 1927.

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Wisconsin fossil mosses. THE BRYOLOGIST **33**: 66-68. 1930.

More fossil mosses from Wisconsin. THE BRYOLOGIST **34**: 93-94. 1931.

Notes on interesting Wisconsin mosses. III. THE BRYOLOGIST **39**: 17-18. 1936.

<sup>1</sup> Conklin, George H. The Hepaticae of Wisconsin. Trans. Wis. Acad. Sci., Arts & Lett. **24**: 197-247. 1929. This catalogue credits to Mr. Cheney 936 specimens, representing 83 species in 49 genera of Hepaticae.

SOME JAPANESE STEREOCAULA WITH BOTRYOSE  
CEPHALODIA

G. T. JOHNSON\*

It has been shown<sup>1</sup> that cephalodial shape in *Stereocaulon* is associated with other morphological characters and is, therefore, of considerable phylogenetic significance. These conclusions have been supported by further study and the writer feels that specialized types of cephalodia provide a basis for the convenient separation of *Stereocaulon* into distinct and natural sections.

Through the kindness of Dr. Carroll W. Dodge I have been permitted to examine an excellent series of Japanese specimens of *Stereocaulon* submitted to him by Dr. Yasuhiko Asahina. Examination of a portion of this material has led to the following notes which should be regarded as the first of a series of preliminary contributions toward a monograph of the genus. Since all specimens cited below possess botryose cephalodia it seems appropriate to describe the new section of the genus to be based upon this character at this time. The diagnosis follows:

STEREOCAULON section **Botryoideum** Johnson, sect. nov.

A *Stereocaulonis* aliis sectionibus differt cephalodiis botryosis.

Differs from other sections of *Stereocaulon* in the possession of botryose cephalodia.

The botryose cephalodium has previously been used as a taxonomic character, both by lichenologists who incorporated the shape of the cephalodium in routine descriptions of species of *Stereocaulon* and by Dodge<sup>2</sup> who keyed out several species of the genus on the same basis. According to Dodge's *Synopsis*, eight species of *Stereocaulon* from Japan and eastern Asia, as well as two doubtful species from New Zealand, could possibly be placed in section *Botryoideum*. Four of these species are not considered in the present treatment because: (1) the types of *S. leptaleum* and *S. corticatum* (the New Zealand species) seen by me<sup>3</sup> are too fragmentary for a final decision as to their disposal; (2) neither types nor specimens of *S. botryophorum* or

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<sup>1</sup> Johnson, G. T. 1938. The taxonomic importance and phylogenetic significance of the cephalodia of *Stereocaulon*. *Ann. Mo. Bot. Gard.* 24: 729-768. 2 figs., 3 pls.

<sup>2</sup> Dodge, C. W. 1929. A synopsis of *Stereocaulon* with notes on some exotic species. *Ann. Cryptog. Exot.* 2: 93-153.

<sup>3</sup> Specimens seen through the courtesy of the curator of the Museum Fennicae to Dr. C. W. Dodge.



*S. foliolosum* (Asiatic species) have been available. Six species of the ten suggested above (*S. curtatum*, *S. exutum*, *S. japonicum*, *S. octomerellum*, *S. prostratum*, and *S. uvuliferum*) and *S. nigrum* (which appears a distinct species rather than a synonym of *S. exutum*) are members of the section described above (all Japanese species). *S. exutum* is the type upon which *S. § Botryoideum* is based.

The portion of this paper which is to follow contains distributional records of seven species of *Stereocaulon § Botryoideum* indigenous to Japan. All species of this section previously described from Japan, as well as others, apparently occur among the specimens examined—an indication that the region has been diligently collected. Some species involved have been reported several times, but the records are of interest in connection with the confirmation and extension of ranges; other species have been reported so rarely that it is pleasing to hear of them again. Still other specimens appear undescribed, but I have reserved decision as to their status pending more mature judgment. Since some doubt has been expressed as to the validity of *S. nigrum* and *S. octomerellum*, complete descriptions of the specimens referred thereto have been included. The other species are somewhat better known and they are merely listed with the citation of the specimens examined. All material cited is deposited in the private herbarium of Dr. C. W. Dodge.

STEREOCAULON CURTATUM Nyl., Lich. Japon. 18. 1890. *Specimens examined*: Asahina No. 609, Mt. Tateyama, Prov. Ettyû, Hondo, 7/29/1928; Asahina No. 632, Mt. Yatsugatake, Prov. Shinano, Hondo, 5/30/1926.

STEREOCAULON EXUTUM Nyl., Lich. Japon. 18. 1890. *Specimen examined*: Asahina No. 641, Mt. Fuji, western side, 10/18/1924.

STEREOCAULON JAPONICUM Th. Fr., De Stereoc. et Pilophor. Comment. 18. 1857. *Specimens examined*: Asahina No. 143, Prov. Kii, Hondo, April, 1925; Asahina No. 619, Mt. Minobu, Prov. Kai, Hondo, 8/8/1922; Asahina and Uematsu No. 623, Mt. Akagi, Prov. Kôdzuke, Hondo, 5/7/1927; Asahina No. 629, Mt. Yatsugatake, Prov. Shinano, Hondo, 5/30/1926; Asahina No. 636, Togo-ike, Prov. Hoki, Hondo, August, 1926.

STEREOCAULON NIGRUM Hue, Nouv. Arch. Mus. (Paris) III. 10: 248. 1898. *Specimen examined*: Asahina No. 642, Hakone, Prov. Sagami, Hondo, 8/12/1925.

Primary thallus evanescent; podetia 1.5–4.0 cm. high, 1.0–2.0 mm. in diameter at the base, erect, sparingly to more profusely branched,

dark in color, glabrous, often divided into main trunk and branches, decorticate at maturity; outer layer of podetium 30–45  $\mu$  in thickness, composed of large (5–8  $\mu$  in diameter) loosely interwoven hyphae; central cylinder of podetium of smaller hyphae more compactly arranged; phyllocladia predominantly coralline, reduced to warts or lacking on the main trunk of branched podetia, often well developed and repeatedly dichotomously or simply branched, of blackish cast, conspicuously whitened near the tips, corticate; cortex of the phyllocladia 30–65  $\mu$  thick, formed of large thick-walled hyphae; medulla of the phyllocladia of slender hyphae oriented longitudinally; algae of the phyllocladia in scattered groups or semilayers 15–60  $\mu$  in thickness, *Protococcus*, of cells 5–12  $\mu$  in diameter; cephalodia botryose, 1.5–2.5 mm. in diameter, usually stipitate, more frequent near the base of young, unbranched podetia where they may occur singly or in clusters, gray to black, with thin wall of interwoven hyphae, containing *Gloeocapsa*; apothecia terminating branches, several per podetium, solitary or with several borne in close proximity, 1.0–2.5 mm. in diameter, with dark black disk, with prominent proper exciple in younger stages, convex at maturity; proper exciple simulating a cortex in appearance, 75–250  $\mu$  in thickness; hypothecium dark, 45–95  $\mu$  thick; hymenium hyaline, 70–95  $\mu$  in height; paraphyses free, filiform, slightly enlarged at the tip; asci 60–75  $\times$  5–7  $\mu$ , somewhat thickened at the tip; spores cylindrical-fusiform, 26–40–(50)  $\times$  4–5  $\mu$ , 3–7 septate.

This species has been confused with *S. exutum* Nyl. with which it is closely related. It seems easily distinguished from the latter species by its dark color, the color being accentuated by contrast with the white apices of the phyllocladia.

STEREOCAULON OCTOMERELLUM Müll. Arg., Nuov. Giorn. Bot. Ital. **24**: 190. 1892. *Specimen examined*: Makino No. 622, Towada-lake, Prov. Mutsu, Hondo, 8/30/1927.

Dodge stated in his *Synopsis* (l. c., p. 131), "type . . . much reduced and unsatisfactory." Sato<sup>4</sup> subsequently reported this species from Mt. Hakkôda (the type locality). The collection cited above agrees with Sato's comment (l. c., p. 13), "this is a distinct species."

Primary thallus evanescent; podetia small, light to grayish, attached to rock, erect, unbranched and terminating in one or branched slightly near the top and terminating in two or rarely three apothecia, 4–10–(rarely 15) mm. tall, 0.5 mm. in diameter at the base, glabrous, decorticate, with central cylinder of hyphae 3–5  $\mu$  in thickness, with outer layer composed of slightly thicker loosely interwoven hyphae, with loose masses of *Protococcus* 15–60  $\mu$  in diameter scattered among the outer interwoven hyphae; phyllocladia varying in shape and lo-

<sup>4</sup> Sato, M. M. 1934. Lichens collected on Mt. Hakkôda. Res. Bull. No. 4, Saito Ho-on Kai Museum. 32 pp. 8 figs., 1 pl.

cation, granular to coralline, usually better developed near the apex of the podetium where they may become slightly more than 1 mm. in length and somewhat branched, often limited to one side of the podetium; cortex of the phyllocladia somewhat irregular, 15-60  $\mu$  thick; gonidia of the phyllocladia *Protococcus*, of cells 3-8  $\mu$  in diameter, more profuse near the upper surface, in small clusters which may unite to form a continuous layer 12-50  $\mu$  thick; medulla of the phyllocladia of very slender hyphae; cephalodia small, botryose, 0.5-1.0 mm. in diameter, sessile or slightly stalked, rarely more than one per podetium located near the base of the podetium, dark gray, containing *Glorocapsa*; apothecia terminal, one, two, or rarely three on each podetium, 1-2 mm. in diameter, convex at maturity, with light brown disk; proper exciple conspicuous in young apothecia, 120-175  $\mu$  in thickness; hypothecium hyaline, 60-85  $\mu$  thick; hymenium 75-100  $\mu$  high; paraphyses filiform; asci 70-85 x 14-16  $\mu$ , thickened at the tips; spores cylindrical-fusiform, 30-55  $\mu$  in length, 3-7 septate.

STEREOCAULON PROSTRATUM Zahlbr., Bot. Mag. Tokyo 41: 340. 1927. *Specimens examined*: Asahina No. 614A, Mt. Tateyama, Prov. Ettyû, Hondo, 7/30/1928; Asahina No. 614B, Mt. Hakkôda, Prov. Mutsu, Hondo, 8/8/1924.

STEREOCAULON UVULIFERUM Müll. Arg., Flora 74: 109. 1891. *Specimens examined*: Asahina No. 612, Mt. Tateyama, Prov. Ettyû, Hondo, 7/30/1928; Asahina and Uematsu No. 624, Mt. Higasi-Koma, Prov. Kai, Hondo, 8/11/1926; Asahina No. 630, Mt. Komagatake, Prov. Shinano, Hondo, 7/26/1926; Asahina No. 631, Mt. Komagatake, Hondo, 8/28/1926.

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ST. LOUIS, MISSOURI

## SOME MARCHANTIALES FROM MEXICO

RUTH DOWELL SVIHLA

During the past two years I have had the opportunity of working on a collection of hepatics from Mexico which were collected during parts of 1938 and 1939 by Dr. and Mrs. T. C. Frye. These specimens were obtained from the states of Morelos, Distrito Federal, Puebla, Michoacán, Vera Cruz, Nuevo León, Hidalgo and Guerrero. The present report covers the Ricciaceae and the Marchantiaceae (in the broad sense) of these regions.

RICCIA AUSTINI Steph. Bull. Herb. Boiss. 6: 336, 1898; Sp. Hep. 1: 28, 1898. DISTRITO FEDERAL: Mirador, 43 km. south of Mexico

City along Cuernavaca road at about 2600 m. altitude, on soil between boulders and tufts of grass (Frye and Frye 2721), May 7, 1939.

Known previously from Rhode Island, Connecticut, New Jersey, Ontario, Nebraska, California, Oklahoma, Texas, Alabama, North Carolina (5).

The Fries' 2721 has conspicuous hyaline scales which extend beyond the margins of the thallus and are similar to the scales of *R. Austini*. *R. Mauryana* from Mexico has somewhat conspicuous hyaline scales but they merely reach the margins or project slightly toward the apex of the thallus. Although the description of *R. Mauryana* is meager and no illustrations are available, the thallus is apparently very similar to that of *R. Austini*.

Cross sections of the thallus of no. 2721 show a median sulcus which is narrow and acute toward the apex but flattens conspicuously in the older parts. In this respect it agrees perfectly with the figures of *R. americana* by Howe (7, pl. 90).

The spores of *R. Mauryana* are described by Stephani as blackish, densely and minutely papillate. If this is true, then no. 2721 is not this species, since its spores are dark brown and areolate. They are obscurely angled and without wing margins like those of *R. Austini*. In color and size (73–109  $\mu$ ) they also agree with typical *R. Austini* (71–126  $\mu$ ). The only disagreement lies in the size of the areolae on the spores. The areolae of the spores of no. 2721 are 6.4–8  $\mu$ ; those of *R. Austini* are mostly 12–16  $\mu$  according to Howe's description.

Specimens of *R. Austini* from different regions of the United States were found to differ in spore characters. These are given below in comparison with the Mexican specimen:

LOUISIANA; side of road cut near St. Francisville (Faith Pennebaker), June 7, 1939. Spores 72–80  $\mu$ , brown, translucent, without wing-margin; areolae 14.4  $\mu$ .

TEXAS; on thin limestone soil; Miller's ranch near Vance, Real (McFadden), Dec. 20, 1925. Spores 81.6  $\mu$ , brown, translucent, with rudimentary wing-margin; areolae 9.6  $\mu$ .

CALIFORNIA; exposed, south-facing hillslope, about one-half mile west of Woodacre, Marlin County (A. M. Carter 391), Oct. 8, 1933. Spores 100  $\mu$ , pale brown (young spores), with rudimentary wing-margin; areolae 9.6  $\mu$ ; exposed bank above Mission Dolores, San Francisco (Howe and Byxbee), Mar. 23, 1896. Spores 75  $\mu$ , purplish at edge, opaque (old spores), without wing-margin; areolae undiscernible.

Since the Fries' 2721 agrees so well in other characters with *R.*

*Austini*, a variation in the areolae of the spores from 6-16  $\mu$  does not seem unreasonable. The Mexican collection above is therefore considered within the scope of *R. Austini* and the range for the species extended far south into Mexico.

TARGIONIA HYPOPHYLLA L. Sp. Pl. 1136, 1753. MORELOS: Cuernavaca, on clay bank about 13 km. northward along road to Mexico City, altitude about 1800 m. (Frye 2222), with *Asterella* sp., Aug. 9, 1938. PUEBLA: Texmelucan, on damp shady roadside bank about 15 km. westward along road to Mexico City (Frye 2902), Aug. 9, 1938. MICHOACÁN: Cerro Grande, on rock, near main Toluca-Morelia highway about 20 km. east, at about 2500 m. altitude (Frye and Frye 2792), May 18, 1939.

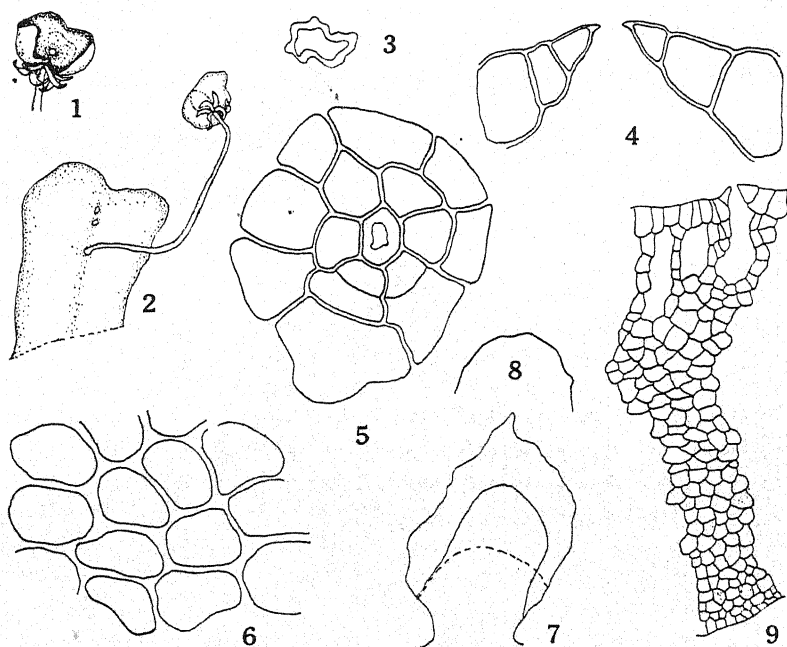
Previously reported from Mexico from the following states: PUEBLA: Chinantla (Liebmann 421b, 424b, 469, 520), (6). Gottsche (6) places Chinantla in the state of Oaxaca. However according to Stieler's Handatlas Pt. 2. 10th Ed. 1930-31, the only Chinantla in Mexico is in the state of Puebla. Evans (1) also locates Chinantla in Puebla thus correcting Gottsche. VERA CRUZ: vicinity of Jalapa (Schiede in Herb. Berolin, No. 106) (6).

PLAGIOCHASMA CRENULATUM Gottsche, Danske Vid. Selsk. Skr. 6: 362, 1863. VERA CRUZ: Córdoba, on rock thinly covered with dirt, about 2 km. west along road to Orizaba, altitude about 960 m. (Frye 2239), Aug. 7, 1938. NUEVO LEÓN: Santiago, on damp soil and rock in spray of Horsetail Fall, altitude about 650 m. (Frye and Frye 2668), Apr. 25, 1939.

Previously reported from Mexico from the following states: CHIAPAS: San Cristóbal (Muench 5607), Nov. 1907 (1). PUEBLA: Chinantla (Liebmann) (6). SONORA: Huchuerache (Hartman 307), Dec. 1890 (1). VERA CRUZ: Orizaba (F. Mueller, type) (6); (Farlow), Feb. 1885; (Smith), 1892; (Conzatti and Gonzales), Dec. 1900; (Barnes and Land 686), Nov. 1908. Córdoba (Farlow), Feb. 1885; (MacIntyre), Feb. 1907; (Barnes and Land 640, 659), Oct. 1908 (1).

This species, according to Evans (3, p. 41), is found only in Mexico. Whereas heretofore it has been recorded only from northwestern (Sonora) and southwestern (Chiapas, Puebla and Vera Cruz) Mexico, Fries' collection adds northeastern (Nuevo León) Mexico to the locality records, indicating a more continuous distribution. The western Sierra Madre range extends through the state of Sonora while the eastern Sierra Madre Mountains pass through Nuevo León in the

north, and Chiapas, Puebla and Vera Cruz in the south. A high, dry plateau separates these two ranges but is evidently no barrier to the distribution of *P. crenulatum*. Further collecting in the central and southwestern regions of Mexico may reveal this species to be widespread through the country.



Figs. 1-9. *PLAGIOCHASMA CRENULATUM*. 1. Female receptacle,  $\times 8$ . 2. Thallus with female receptacle,  $\times 4$ . 3. Cross section through female receptacle stalk,  $\times 18$ . 4. Cross section through epidermal pore,  $\times 335$ . 5. Surface view of epidermal pore,  $\times 335$ . 6. Epidermal cells,  $\times 335$ . 7. Normal appendage of thallus scale; hyaline outside the dotted line; contorted cells outside the solid line,  $\times 18$ . 8. Tip of appendage showing rounded margin,  $\times 18$ . 9. Cross section through thallus,  $\times 77$ .

There are some illustrations of this species by Evans (1). Supplementary drawings are shown here in figures 1-9. Although the majority of scale appendages are apiculate or abruptly acute (fig. 7), some were found with almost entire margins (fig. 8). They all have irregular and contorted cells toward the margins as in normal *P. crenulatum*. Evans (3, p. 292) states that specimens collected by Hartman from Sonora came close to the East Indian species *P. appen-*



*diculatum* Lehm. and Lindenb. in that the scale appendages had rounded apices and entire margins. However, *P. appendiculatum* is described as differing from *P. crenulatum* in that it has large appendages with the contorted cells confined to a very narrow border. Practically all the scale appendages of Fryes' 2239 and 2668 were at least one-third or one-half hyaline as shown by the dotted line in figure 7.

REBOULIA HEMISPHAERICA (L.) G. L. & N. Syn. Hep. 548, 1846. VERA CRUZ: Córdoba, on boulders about 2 km. westward on road to Orizaba, altitude about 960 m. (Frye 2240), Aug. 7, 1938.

Previously reported from Mexico from the following state: VERA CRUZ: Orizaba region (F. Mueller) (6). Stephani (11) refers to a Mexican collection by Stahl but we do not know its origin.

DUMORTIERA HIRSUTA (Sw.) Reinw. Bl. & Nees, Nova Acta Acad. Caes. Leop.-Carol. Nat. Cur. 12: 410, 1824. VERA CRUZ: Córdoba, on wet rocks along stream about 2 km. westward along road to Orizaba, altitude about 960 m. (Frye 2244), Aug. 7, 1938. MORELOS: Cuernavaca, on wet rocks at San Antonia Cascada (Frye and Frye 2744, 2745), May 10, 1939. DISTRITO FEDERAL: Desierto, along streamlet in forest, altitude about 3500 m. (Frye and Frye 2830) intermingled with *Mitsergia*, May 20, 1939.

Previously reported from Mexico from the following states: PUEBLA: Chinantla (Liebmann) (6). VERA CRUZ: Mirador (3000') and Colipa (500-800') (Liebmann) (6).

PREISSIA QUADRATA (Scop.) Nees, Naturg. Eur. Leberm. 4: 135, 1838. VERA CRUZ: Córdoba, on clay bank in shade about 2 km. westward along road to Orizaba, altitude about 960 m. (Frye 2241), Aug. 7, 1938. HIDALGO: Chapulhuacan, about 5 km. south along highway on clayey bank of cut, altitude about 2000 m. (Frye and Frye 2846), May 24, 1929.

Previously reported from Mexico by Stephani (11); by Evans and Nichols (4) "———south to Mexico"; by Massalongo (9); by Mueller (10).

MARCHANTIA POLYMORPHA L. Sp. Pl. 1137, 1753. HIDALGO: Jacala, on soil of cut along road to Tamazunchale, about 10 km. north of town, altitude about 1300 m. (Frye 2904), Aug. 2, 1938; Chapulhuacan, on ground of roadway cut (Frye and Frye 2848), May 24, 1939. PUEBLA: Texmelucan, on damp sandy roadside bank, about 15 km. westward along road to Mexico City (Frye 2903), Aug. 9, 1938.

GUERRERO: Taxco, about 2 km. south along highway on dirt beside spring, altitude about 1600 m. (Frye and Frye 2751), May 14, 1939.

Previously reported from Mexico from the following states: VERA CRUZ: Mt. Orizaba (Mueller 2245) (6). Mirador (Mohr), Apr. 1857; Orizaba (Smith), Jan. 1892 (2). DISTRITO FEDERAL: Cañada San Magdalena, Contreras (Barnes and Land 455, 458), Oct. 1908 (2). PUEBLA: banks along Avenida Hidalgo and path to barranca, Tezuitlan (Barnes and Land 541, 542), Oct. 1908; Santa Barbara near Puebla (Frère Nicolas 20), Nov. 1909 (2). OAXACA: near Miahuatlán (Nelson 2430), 1895 (2).

MARCHANTIA PALEACEA Bertol. Opus Sci. Bologna 1: 242, 1817. HIDALGO: Chapulhuacan, about 5 km. southward along highway on clay bank, altitude about 2000 m. (Frye and Frye 2851), May 24, 1939.

Previously reported from Mexico from the following states: PUEBLA: Chinantla (Liebmann) (6). Puebla (Frère Arsène) 1906; Honey Station (Barnes and Land 507) 1908; banks along Avenida Hidalgo and path to barranca, Tezuitlan (Barnes and Land 544); Santa Bárbara, near Puebla (Frère Nicolas 3) 1909 (2). VERA CRUZ: Orizaba (Mueller 2245 in part) 1855; walls of Lost River Sink, Orizaba (Barnes and Land 668) 1908 (2). OAXACA: Oaxaca (Sommerchu) (6).

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SOME HISTORICAL FACTORS AND THE DISTRIBUTION  
OF SOUTHERN APPALACHIAN BRYOPHYTES<sup>1</sup>

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American bryologists have devoted themselves primarily to taxonomy and morphology. Such attention as has been given to the ecology of bryophytes has emphasized environmental factors and correlations with communities of vascular plants. Geological factors and their effects on the modern distribution of bryophytes have been virtually ignored, except for a few recent publications, notably by Steere (1937).

The present paper deals principally with prehistoric factors and their possible influences on the distribution of bryophytes indigenous to the Southern Appalachians, including the Cumberland Plateau and Mountains. It is assumed that during Tertiary times a relatively uniform vegetation extended from Canada to the highlands of Mexico and Central America, and southeast to the area now composing the Southern Appalachians; the Coastal Plain then was not yet evolved. The relatively new and curious patterns of distribution evident today were created by certain geological events, not all of the effects of which are easily demonstrated. The distribution of the Southern Appalachian vascular plants, and some of the factors involved, have been discussed by Braun (1937), Cain (1930), Core (1938), Fernald (1931), and Kearney (1900).

Peneplanation followed by elevation is thought by Braun (1937) to account for some of the relationships existing between the vascular flora of the Cumberlands and the Coastal Plain. It would be equally satisfactory in explaining the distribution of such bryophytes as *Cryphaea nervosa*, *Syrrophodon texanus* and others indicated by Sharp (1939).

The Mississippi Embayment which extended to southern Illinois certainly bisected any continuous ranges which extended from the Southern Appalachians to the west and southwest. This embayment was a factor in the disjunction of the ranges of the vascular species common to the Ozarks and the eastern mountains (Palmer and Steyermark, 1935). Enough is not yet known about the bryophytes in the Ozarks to be certain, but it is probable that many species will show the same disjunction.

<sup>1</sup> Contributions from the Botanical Laboratory, The University of Tennessee, N. Ser. 37.

The possible effects of continental glaciation are numerous and many are difficult of evaluation. Isotherms were shifted southward and were telescoped on mountain slopes during periods of glacial advance. It is worth noting that red spruce is found as a disjunct at 2800 ft. elevation in a boggy swamp in Shady Valley, Tennessee, and white spruce fossils have been found in Louisiana (Brown, 1938). This lowering of temperatures probably extinguished some species formerly present in the Southern Appalachians. Glaciation certainly destroyed northern outposts of many of the bryophytes. Aggressive northern species not previously existing in the Southern Appalachians may have migrated southward and subsequently met one of three fates: (1) they may have later retreated northward, leaving no record in the south, (2) they may now have a continuous range to the north, (3) they may still be restricted or endemic in these mountains. As a result of glaciation, the number of species in the Southern Appalachians must have been substantially increased. Many pre-glacial habitats both in this area and to the north must have been destroyed and new postglacial habitats created. For example, the preglacial and postglacial forests were probably quite different, thus supporting dissimilar arboreal bryophytes. Rock and soil habitats in glaciated areas are certainly not the same today as they were in preglacial times.

Moreover, glaciation dammed north-flowing rivers and stopped northward migration of some species. The outwash from the lakes formed by the dammed streams may have assisted in the disjunction of the ranges of species now common to the Southern Appalachians and the mountains to the west, particularly the Ozarks. Bryophytes which formerly had an arc-like range from the Southern Appalachians through Canada to the western Cordillera were certainly obliterated in the north by glacial ice, and many apparently never re-established themselves there.

Shifting of climates as postulated for interglacial and particularly postglacial times (Sears, 1932), would certainly widen the gaps in the ranges of many species. Regardless of the order in which the shifts occurred, any xeric period would have extinguished the more mesic species except in the moist ravines of the southeastern, central and perhaps the western mountains. A dry climate would have permitted the eastward migration of xeric species. Prairie vascular plants are known on the over-drained soils on the Cumberland Plateau and at the edge of the higher mountains. Eastern outposts of xeric bryo-

phytes, such as *Grimmia Wrightii* and *Husnotiella* sp., are found in Oklahoma and Missouri, while *Hymenostomum tortile* and *Pleurochaete squarrosa* are found in eastern Tennessee. It is not improbable that these and other species arrived east of their areas of frequent occurrence during the drier periods.

Many of the prehistoric phenomena (peneplanation, Mississippi Embayment, glaciation, xeric periods) just mentioned may help account for the disjunction of the ranges of certain "tropical" bryophytes (Sharp, 1937) found in the Southern Appalachians. The emergence of the southern Coastal Plain certainly provided a "highway" for the migration of tropical species to the north. Many show a continuous range to their northern limits in the Southern Appalachians (Sharp, 1939).

The present discussion does not attempt to provide an exhaustive survey of the prehistoric factors and their effect on the distribution of bryophytes but rather to demonstrate the necessity and usefulness of a study of such factors in conjunction with bryogeographical research.

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THE LATERAL LEAF SCALE OF *RIELLA AMERICANA*

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## INTRODUCTION

Brief descriptions of mature "leaves" have accompanied taxonomic and other accounts of all of the species of the hepatic ruffle plant, *Riella*. The genus has been known to science for over a century and, because it is anomalous in so many respects, there is a voluminous literature on its seventeen species. But to the same degree that the *Riella* research papers are well supplied with brief statements on the mature scales, they are deficient in studies on their morphological development. In this paper a review is given of the literature applicable to both kinds of scales in *Riella*.

The simple dissection methods used in the study of gemmae (11) were continued in this investigation. Corroborative information was also obtained from prepared slides. The lateral leaf scales were studied mainly in older plants, but to some extent also on gemmalings; both living and preserved materials were used.

## REVIEW OF LITERATURE

Hofmeister (6) was apparently the first to report on the developmental stages of the scales of *Riella*. He recognized the presence of two distinct kinds of scales in *Riella Reuteri*, each found in two longitudinal rows on the axis. A scale (presumably of either kind) originates, he said, from the division of a single cell which protrudes above the surface at the tip of the axis. Those scales which are nearest to the front of the axis, and which we now call ventral scales, develop in the same manner as do the scales of ferns; Hofmeister gave no details. Scales of the other type, which lie nearest to the wing, and which are at present called lateral leaf scales, are considerably and unsymmetrically developed in width in their middle region. Hofmeister's drawings illustrate the primordial or initial cells of these latter scales, as well as several of their developmental stages.

With such an excellent beginning nearly a century ago, it is surprising that later workers have added relatively little to Hofmeister's data and that even the fact that two kinds of scales are present in many if not all species had dropped almost completely from sight until recent years.

Leitgeb (8) described the sequence of cell divisions from the apical

master cell to the formation of the various organs, including scales. He seems to have dealt with both kinds of scales without realizing it. His sequence for *Riella Parisii* apparently leads to the lateral leaf scale, while that for *R. Reuteri* seems to lead wholly to ventral scales. Every scale, Leitgeb emphasizes, originates from a single cell, forms a filament with a globular papilla at the apex, and finally grows into a narrow or broad cell plate. Some developmental stages are figured, but they represent a mixed series including both scale and gemma, as already noted by Studhalter and Cox (11).

Goebel (3), working with *Riella Clausonis*, added little information on the development of scales, although he probably dimly realized that two types are present.

Howe and Underwood (7), in reporting studies on *Riella americana*, believed that they were describing only mature scales of a single kind; the brief description and the single figure show these to be mainly lateral leaf scales. They did not fail to find the ventral scales, but thought they were gemmae, as discussed in a previous paper (11).

Cavers (1) apparently thought there was only a single kind of scale in *Riella capensis*. But his finding of the terminal papillose mucilage cell and the brief statement that the scale begins its growth with this cell indicate that, here at least, he was dealing with the ventral scale. However, he mistook these for developmental stages of the lateral leaf scale, which he described as a mature structure for its taxonomic interest.

Porsild (9) also recognized only one scale type. Several developmental stages, including the initial cells, are figured for *Riella Paulsenii*.

Solms (10) barely mentioned scales, but showed diagrams of scale initials and of a scale about seven cells long in *R. Parisii*. The figures show almost certainly that their very young stages are associated with mucilage cells; hence they are ventral scales.

Goebel (4) illustrated with little comment a scale seven cells long with one terminal and one marginal mucilage cell in *R. helicophylla*, which is certainly a ventral scale. He still did not mention the presence of two kinds of scales.

In a later paper, Goebel (5) did not discuss scales at all, but gave three illustrations of scales of different ages, two in *R. Cossoniana* and one in *R. Clausonis*, all of which prove to be ventral scales. They show both terminal and marginal mucilage cells.

In another paper, Cavers (2) noted a definite correlation in the several species of *Riella* known in 1910 between the breadth of the wing and the size of the scales; the broader the wing, the smaller the "leaves," and vice versa. Lateral leaf scales are referred to.

Vraber (12) found similarities between the early developmental stages of gemma and scale (probably ventral scale), and agreed with Goebel's idea of the homology of these structures.

Wigglesworth (13) distinguished clearly between the mature lateral leaf scale and the mature ventral scale in several species of *Riella* from South Africa.

Studhalter and Cox (11) described the relative positions occupied on the axis of *R. americana* by lateral leaf scales, ventral scales, and gemmae.

It is apparent, then, that there is not available a single complete series of developmental stages for the scale in any species of *Riella*, and that where incomplete series are given there is usually confusion between the two types of scales, and even between scale and gemma. The morphology of the lateral leaf scale is considered in this paper; that of the ventral scale is reserved for the future.

#### ORIGIN AND DEVELOPMENT

The lateral leaf scale is considerably larger than the ventral scale or the gemma and its position on the plant is quite different. It originates above the tip of the axis, just above the major growing region of the plant. Its primordium faces ventrally or slightly upwards. As growth of the axis and its adjacent parts proceeds, the lateral leaf scale is gradually displaced dorsally over the top of the axis and it ultimately comes to occupy a dorsal position on the axis very close to or touching the wing. Since primordia are formed on either side of the plant, mature lateral leaf scales are also located at either side of the wing. This lateral position and their leaf-like shape give them their name. They are usually associated with archegones for which they serve as effective protecting structures. The peculiar position of antherids in *Riella* does not permit protection by the lateral leaf scales, except sometimes in their earliest stages.

The ontogeny of the lateral leaf scale is relatively simple. The initials which, like the mature scales, are never numerous, are found several cells removed from the ventral margin of the plant above the apex of the axis. They are large cells, with dense cytoplasm and



prominent nuclei. Chloroplasts are present and there is no evidence of mucilage, this latter point as well as their location on the plant distinguishing them from the initial cells of ventral scales. They soon protrude above the surrounding cells (fig. 1).

The first cross wall is parallel to the ventral margin of the plant and perpendicular to the long axis of the primordium (fig. 2). The outer cell thus formed is the smaller of the two and it protrudes wholly or nearly so above the surrounding cells. The inner and larger cell remains embedded.

The three-celled stage (fig. 3) is still a filament, formed as a result of the division of the embedded cell of the previous stage by a cross wall nearly parallel with the first one. The curvature found in nearly all lateral leaf scales is already apparent at this stage. The three cells are approximately equal in size. There is usually no indication of mucilage in the terminal cell. The intermediate cell is responsible through its cell divisions for the formation of the body of the lateral leaf scale. The embedded basal cell contributes to the formation of the multicellular base. The filamentous stage is a short one both in time and in the number of cell generations; it usually stops at the three, four, or five-celled stage (fig. 4).

The first division to change the filament into a plate of cells usually takes place in the sub-basal cell (fig. 5), but it may occur in the cell above this one. The new wall formed is perpendicular to the other cross walls. The derivatives of the middle cell of the three-celled stage soon form a plate of cells which for a time remain a distinct unit set apart from the other cells of the scale (figs. 6, 7).

The terminal cell usually secretes mucilage when the scale is composed of three to five cells. Since this cell rarely becomes papillose and also seldom becomes displaced ventrally by overgrowth of the cell plate, we propose for it the name, terminal mucilage cell, to distinguish it from the papillose mucilage cell of the ventral scale and the gemma. There is no evidence that this terminal cell ever divides after it is cut off from the primordium.

The basal cell, however, divides freely, beginning its activity shortly after the cell plate has begun to be formed. Its first cross wall is parallel with the long axis of the scale, giving the latter a broad base (fig. 7). Later divisions across the long axis, however, soon form a unistratose rectangle of cells, the lower of which are embedded and the upper of which stand above the surface of the surrounding cells (fig.

8). Up to this stage there has remained a clear demarcation of those parts of the scale derived from each of the cells of the three-celled filament, even though it is now clear that derivatives of the basal cell are present above the embedded part of the scale.

Marginal mucilage cells are generally first visible when the scale is two cells wide and eight or nine cells long (fig. 8). However, a scale of this length is often three cells wide, at least in part.

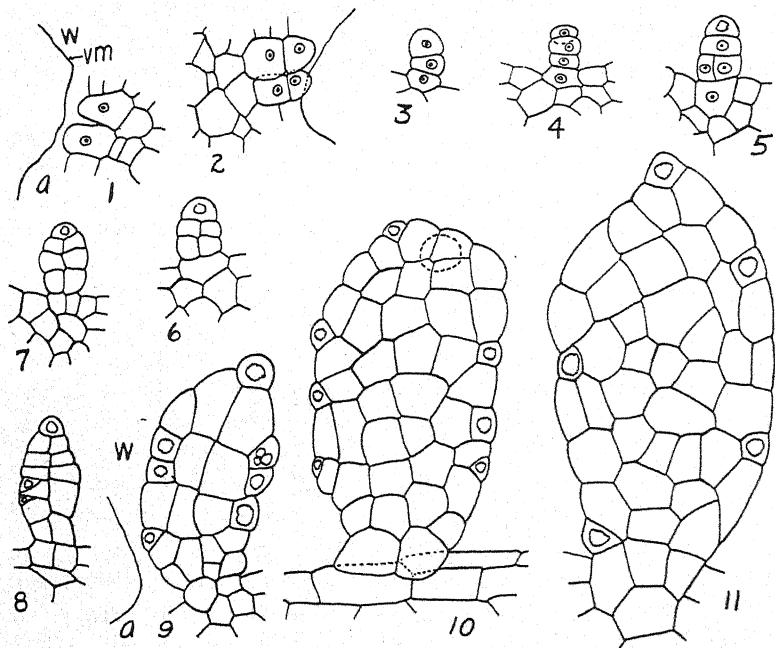
As the lateral leaf scale approaches maturity, the marginal mucilage cells may be either quite numerous (fig. 9) or few in number (fig. 11). The scale is not only curved on its long axis, but may also be bent laterally from its base (fig. 9) as a result of more rapid growth at one side. Its cells remain quite large, except for the mucilage cells.

At these stages there is usually no demarcation between body and base of the scale (figs. 10 to 15), which is at first uniformly a single layer of cells in thickness. At about the stage shown in fig. 9, cell divisions take place in the third plane at the base, this being the only region of the lateral scale which becomes thickened. This growth in the third dimension comes from the embedded cells of the base as well as from two to four tiers of exposed cells. It seems certain that the zone of thickening involves all cells derived from the original basal cell in the three-celled filament. With a thickened base, the lateral leaf scale becomes truly linguiform. In the accompanying illustrations, no effort is made to show this thickening in the third dimension except in figs. 16 and 17. No such thickening occurs in ventral scale or gemma. The terminal mucilage cell may still be present or else it may become lost. In any event, it has neither enlarged nor become papillose, and it contains less mucilage than its homologues in the ventral scale and the gemma. The width of the base varies materially, that shown in fig. 12 being unusual in that it is the broadest part of the scale. Stages closely approaching maturity are shown in figs. 13 to 15. Cells remain rather uniformly large.

At maturity (fig. 16), the lateral leaf scales are relatively large, few in number, long distances apart, and obliquely oriented on the axis in varying directions. They may or may not touch the wing, are located on both sides of the axis, and are at times found associated with aborted archegones or young sporophytes. They reach maturity at about the time they are located vertically above the tip of the axis.

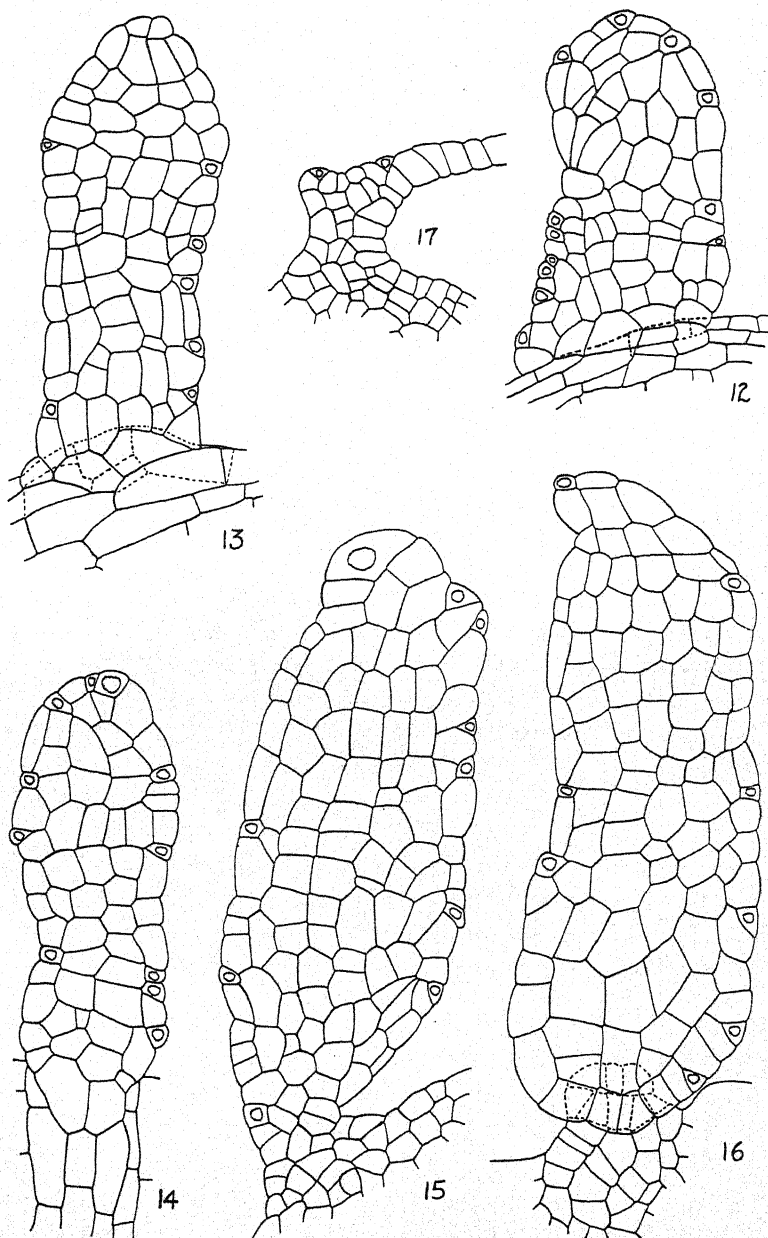
In shape, the mature lateral leaf scale is ovate or oblong or rarely obovate or irregular; considering its thickened base, it should be





Figs. 1 to 11. *RIELLA AMERICANA*,  $\times 230$ . Mucilage is shown diagrammatically by a wavy line, which is not indicative of its true shape, especially in the terminal mucilage cell. 1. Two primordia of the lateral leaf scale, several cells removed from the ventral margin, *vm*, of the plant; region of axis, *a*; wing, *w*. 2. Two young lateral leaf scales in two-celled stage. 3. Three-celled stage of lateral leaf scale. 4. Four-celled stage, showing slight displacement of terminal cell. 5. Division of sub-basal cell, the first step in the formation of a cell plate; terminal cell has secreted mucilage. 6. Six-celled scale with undivided attachment cell. 7. Cell plate of nine cells. 8. Cell plate showing three distinct regions: terminal mucilage cell; eleven cells, including two marginal mucilage cells, all derived from the intermediate cell of the three-celled stage; and five cells, partly embedded and partly protruding, derived from the basal cell of three-celled stage. 9. Lateral leaf scale four cells wide, showing orientation with regard to axis, *a*, and wing, *w*. 10. Older lateral leaf scale with terminal mucilage cell (dotted line) somewhat displaced and grown over by the cell plate. 11. A still older stage with terminal mucilage cell at apex, not displaced.

Figs. 12 to 17. *RIELLA AMERICANA*,  $\times 175$ . Mucilage is shown diagrammatically by a wavy line, which is not indicative of its true shape, especially in the terminal mucilage cell. 12. Lateral leaf scale, half mature, with unusually broad base. 13. Still older stage. 14. Long, slender lateral leaf scale, approaching maturity. 15. Nearly mature lateral leaf scale, bent laterally on its base at a sharp angle. 16. Mature lateral leaf scale; base, shown in part with dotted lines, is multicellular and stands at right angle to cell plate. 17. Lateral view of base of a mature lateral leaf scale.

*RIELLA AMERICANA*

called linguiform. As seen in surface view of the axis, the attachment is represented by a narrow oval, often pointed at one end, and one to three cells in width. The apex of the scale is generally obtuse or occasionally acute. Its base is multicellular, and varies much in breadth and somewhat in thickness. The margin is usually entire, but frequently irregularly crenate.

Its entire length ranges from 475 to 800  $\mu$ , with an average of about 625  $\mu$ . The greatest width averages about 260  $\mu$  and varies from 150 to 400  $\mu$ . The length of the scales, as given by Howe and Underwood (7) (0.2 to 0.6 mm.) clearly includes both ventral and lateral leaf scales.

In fig. 16 the terminal mucilage cell is still present, and there has been no tendency for the subterminal cells to grow over and beyond it. In the basal region overgrowth does not occur in exactly the same sense as in ventral scales and gemmae, but the tendency is sometimes apparent, as is shown in lateral view in fig. 17 and by the dotted cells in surface view in fig. 16. Most frequently, however, there is little or no tendency of this kind.

The cells of the entire mature scale remain large, with the exception of the mucilage cells. The nucleus is rather prominent and the cytoplasm meager and peripheral. Chloroplasts are uniformly present except in mucilage cells, but they are less abundant than in the gemma, making the latter structure much more intensely green than either type of scale. The mature lateral leaf scale remains one cell in thickness, except at its base.

#### SUMMARY

Two kinds of scales are distinguished for the first time for *Riella americana*. The large lateral leaf scale is derived from a single cell, forms a filament of three to five cells, and broadens to a cell plate. At maturity it has large cells and numerous marginal mucilage cells. The terminal mucilage cell is neither enlarged nor displaced ventrally. The multicellular base is enlarged in three dimensions, sometimes showing a tendency to be overgrown by the body of the scale.

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## REVIEW

ANDREW DENNY RODGERS III. "Noble Fellow" William Starling Sullivant. i-xxii + 1-361. *Frontis., 15 pl., 3 maps.* G. P. Putnam's Sons, New York. 1940. (\$3.50)—It is peculiarly appropriate that the biography of William Starling Sullivant, "the father of American bryology," should be reviewed here, since the organization which publishes *THE BRYOLOGIST* is named in his honor, and since the book itself is dedicated to the Sullivant Moss Society.

The author, a great grandson of Sullivant, tells a story of absorbing interest to both the botanist and the historian. The influential Starling and Sullivant families left their imprint on the early history of Virginia, Kentucky, and southern Ohio. They owned the land upon which the city of Columbus, Ohio, was founded, and they were responsible for the selection of this site as the capitol of the state. Important landmarks in Columbus today are Sullivant Avenue and the Starling Medical College, since 1914 a part of the Ohio State University. Against this background of pioneer Ohio, the author develops his story of a great botanist and a great American.

Sullivant is known to all botanists, of course, for his contribution of text and plates of the Musci and Hepaticae to the first four editions of Gray's "Manual of Botany," for his sumptuous and elaborate Musci exsiccati, and for his monumental "Icones Muscorum" and its "Supplement." Mr. Rodgers' book gives a clear and much-needed picture of the man himself, his personality and his philosophy

of life. Much light is shed on the little-known facts of Sullivan's correspondence, friendship, and travel with Asa Gray, his aid to and collaboration with Leo Lesquereux, Thomas P. James, and Coe Finch Austin, and his support of expeditions of the famous botanical collectors, Charles Wright and Augustus Fendler. The high regard of Asa Gray for Sullivan is well shown by many remarks in his published correspondence. In a letter to Sir William J. Hooker (not "Hooper," as unfortunately misspelled on the flyleaf), he said: "A noble fellow is Sullivan and deserves all you say of him and his works. The more you get to know of him the better you will like him." From this passage the author has chosen the title of his book.

As indicated on its title page, the biography is provided "With a foreword by Dr. Adolph E. Waller" of the Ohio State University, and "With a compilation of the new species of mosses and liverworts described by William S. Sullivan and those described by William S. Sullivan and Leo Lesquereux, prepared by Richard T. Wareham of the Ohio State University." The appendix prepared by Dr. Wareham will prove especially useful to bryologists, since it is not only a "compilation of the new species," but an up-to-date source of information concerning their present disposition. The usefulness of the book to botanists is also augmented by three bibliographies which appear in the appendix ("Book titles and authors referred to in text," "Works of William S. Sullivan," and "Bibliography of the published material used in the preparation of this book") and by a very complete index to the volume.

It is a pleasure for me to recommend this stimulating and informative book to the members of the Sullivan Moss Society.—W. C. S.

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# THE BRYOLOGIST

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## THE VENTRAL SCALE OF *RIELLA AMERICANA*

R. A. STUDHALTER AND MARTHA ENNA COX

The ventral scale of the American ruffle plant, *Riella americana*, is of particular interest because of its similarity in various ontogenetic stages to the lateral leaf scale and to the gemma. A previous paper (6) has reviewed all essential literature on the morphology of both types of scales in the genus *Riella*. The methods used in the present study of the ventral scale of *R. americana* are the same as those described in the earlier paper. The young ventral scales were studied to a large extent on gemmalings and other young plants, and all stages were studied on older plants. In some instances it was possible to culture gemmalings in water and to follow a single ventral scale through several cell generations; this method is of particular interest for the very early stages of development.

### ORIGIN AND DEVELOPMENT

Ventral scales receive their name from the fact that they occur at the front or ventral surface of the axis, opposite the line of attachment of the wing. On younger plants of *Riella americana* they are formed just below the major growing zone at the top of the axis, on its ventral side. In older plants they still occur on the ventral surface of the axis but much further removed from its top, there being a region of gemmae above them. In mature plants, there is often a reversed progression of ages of the ventral scales in that the oldest are found toward the upper part of the axis, just below the gemmae, and progressively younger scales are found further down (figs. 5, 6). Tangentially, the ventral scales occupy a zone of not more than 60 degrees



on either side of the middle ventral line of the axis, as was found also to be true of gemmae. There is a more or less regular progression from the ventral scale initials, which occur adjacent to the middle ventral line, to the mature scales, which are found 50 to 60 degrees on either side of this line.

On gemmalings, ventral scales are produced at an early stage, while the plant is still a simple plate of cells and before it becomes differentiated into wing and axis.

The developmental stages of the ventral scale are essentially the same whether they are found on the axis of older plants or on the undifferentiated unicellular leaf-like thallus of a gemmaling. However, there are two differences which occur more or less constantly. In the first place, nearly all individual cells are small in scales found on gemmalings, their size being comparable to those of young gemmae. Small-celled young scales were also the invariable rule on gemmalings grown in laboratory culture. On the other hand, ventral scales found on the axis of older plants collected in the native habitat of the American ruffle plant are large celled and very often excessively so. Secondly, the cells of the gemmaling scales seem to stick together so that they have extensive wall surfaces between them. As opposed to this, some of the scales found on the axis of an older plant, especially those of middle age and with excessively large cells, have their cells only loosely held together; these cells are rounded and often jut out at odd angles. Since these differences are not of major consequence, only one account is given for the ventral scale, and the accompanying illustrations are selected from scales derived from both sources.

The primordial or initial cell of the ventral scale is a surface cell of the axis of an older plant or a marginal cell near the lateral meristematic region of the gemmaling. Any surface cell in the proper region can become a ventral scale initial. Such cells, often close together, may be triangular or rectangular. It appears that in all cases the primordium of the ventral scale is associated with the deposition of mucilage; mature mucilage cells do not divide, but primordia always appear to be cells which are just beginning to deposit mucilage (fig. 1). The mucilage at this stage is usually found in one irregularly rounded mass occupying a position near the wall at the free surface.

Such a cell soon protrudes beyond its neighbors, the dome-like papilla being more or less definitely oriented away from the base of

the gemmaling, or in older plants toward the middle ventral line of the axis. The mucilage, which at this stage is not dense, is pushed toward the top of the dome and the nucleus takes up a position at the other end of the cell. Chloroplasts are small and few in number.

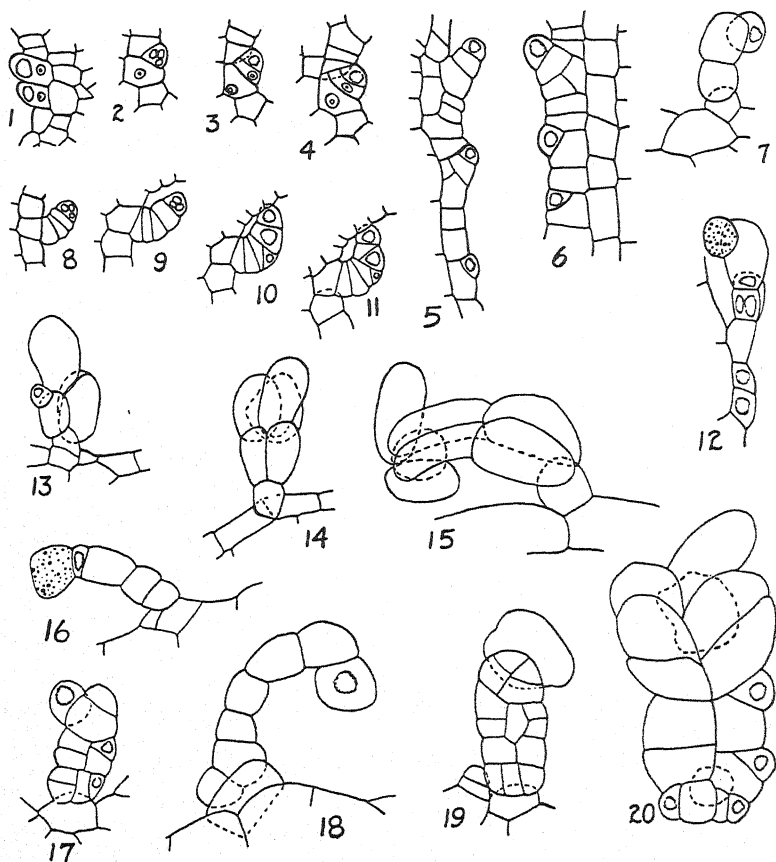
Actual division of the cells has not been observed. Under cultural conditions in the laboratory, however, a cell division occurs every one to three days in a young scale; any one cell divides more rarely.

The first cross wall is invariably oblique and divides the primordium into two unequal cells (fig. 2). The outer cell is small and is very apt to be triangular as seen in surface view, with one free rounded wall, which extends slightly above the surrounding cells; it occupies a position toward the top of the gemmaling or toward the middle ventral line of the axis, in the same direction toward which the dome of the primordium had pointed. This cell contains a small nucleus, is free of chloroplasts, and possesses all of the mucilage which had been present in the primordium. All available evidence indicates that it is incapable of further cell division. Its future behavior varies. Sometimes it retains its terminal position through many later stages of development, in which case it does not become much enlarged. In most instances, however, its later behavior is identical with that of the similarly situated papillose mucilage cell of the gemma. In the latter instances, the essential difference between the two terminal cells is the time at which they first secrete mucilage, the terminal cell of the ventral scale doing so several cell generations earlier than that of the gemma. Because of the close similarity to its homologue in the gemma, this terminal cell in the ventral scale is henceforth called by the same term, namely, papillose mucilage cell.

The larger and more basally located cell has a larger nucleus, several small chloroplasts, and a much reduced free wall surface, which shows only a slight bulge.

In addition to many observations on preserved material, the results of the next two cell divisions were also observed on a single ventral scale on a gemmaling in culture in the laboratory (figs. 2, 3, 4). Its two-celled stage has been described in the two preceding paragraphs. The next division takes place in the basal cell. The cross wall is parallel to the first cross wall and hence oblique with reference to the basal cell (fig. 3). The outer cell thus formed, which is now the intermediate cell of the three-celled stage, is quite short, light green in color, and with a prominent nucleus. The inner cell, which will





Figs. 1-20. *RIELLA AMERICANA*,  $\times 230$ . Mucilage is shown diagrammatically by a wavy line, which is not indicative of its true shape, especially in the papillose mucilage cell. When overgrown by the cell plate, papillose mucilage cell and attachment cell are shown with dotted lines. 1. Initial cells of the ventral scale, dome-shaped, and showing the beginning of mucilage accumulation; from a gemmaling. 2, 3, 4. Successive stages in the development of the same scale in water culture of a gemmaling: 2, two-celled stage, with prominent mucilage cell; 3, the same twenty-four hours later, after another cell division; 4, the same, showing increase in size of cells, two days after the preceding stage. 5. Three stages in the development of ventral scale at margin of a gemmaling. The sequence seems reversed since the oldest stage is nearest the wing (toward top of page). In the middle scale, the basal cell has divided by a division parallel with the long axis of the scale. In the upper scale there appear to have been several divisions in the original basal cell; this type of division is unusual. 6. A sequence similar to that shown in fig. 5, the upper scale showing the method of protrusion above the face of the axis; from a gemmaling. 7. More usual four-celled filament, showing papillose mucilage cell, single basal cell, and division of the intermediate cell; tendency toward overgrowth shown at both apex and base; from an older plant. 8-11. Four

henceforth be called the attachment cell, is still the largest of the three, has a very prominent nucleus, and several chloroplasts of normal size. Forty eight hours later no further cell division had taken place, but each of the cells had increased appreciably in size (fig. 4).

The next cell divisions may take place either in the intermediate cell or in the basal cell. In many instances the latter does not divide further but becomes the single attachment cell of the ventral scale (figs. 7-11). In other instances, however, it divides further into two or three cells (figs. 5, 6) in a manner quite comparable to the divisions which take place in the surrounding undifferentiated cells. Such cell divisions are the cause of the occasional broad multicellular attachments of the ventral scales. In other instances the cells thus cut off from the basal cell join the surrounding cells of the axis in their further activities, leaving a single derivative cell to become the single attachment cell (upper scale in fig. 5).

More often, however, the next division takes place in the intermediate cell of the three-celled stage. This is shown clearly by the shape of the cells in fig. 7, a four-celled stage from an older plant, and is quite safely inferred from the two cross walls forming the five-celled stage shown in fig. 8 from a gemmaling. A comparison of these two figures, drawn to the same scale, illustrates the difference in the size of the cells in ventral scales taken from older plants and from gemmalings, respectively.

Scales are never as deeply green as are the gemmae, but all the cells of the ventral scale to this point contain a reasonable number of

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successive stages in the development of the same scale in water culture of a gemmaling: 8, five-celled stage; 9, the same in six-celled condition, two days later; 10, the same two days after the preceding, showing the first marginal mucilage cell and mucilage being secreted in the sub-terminal cell; 11, the same in eight-celled stage, with two marginal mucilage cells, one day later than the preceding. 12. Lateral view of five-celled filamentous stage showing displacement of papillose mucilage cell and its mucilage scattered in numerous small drop-like masses; from an older plant. 13. Cell plate of large-celled, loosely connected seven-celled stage with divided basal cell; from an older plant. 14. Later stage of same kind of ventral scale with single attachment cell and displaced papillose mucilage cell; from an older plant. 15. Unusual cell plate with cells loosely connected and standing out at unexpected angles; from an older plant. 16. Lateral view of ten- or eleven-celled ventral scale; from an older plant. 17. Older cell plate showing successive broadening from base to apex, lateral as well as ventral displacement of papillose mucilage cell, and growth of cell plate over the attachment cell; from a gemmaling. 18. Lateral view of ventral scale showing method of growth over and displacement of both basal cell and papillose mucilage cell; from an older plant. 19. Surface view of ventral scale two and three cells broad; from a gemmaling. 20. Older cell plate with tendency toward isthmus formation; from an older plant.

chloroplasts, except the papillose mucilage cell. An upward or a ventral curvature of the filament of three, four, or five cells is always evident.

Figs. 8 to 11 represent a second series of observations on several successive days on a living ventral scale found on a gemmaling. The papillose mucilage cell and the attachment cell remain essentially unchanged from the filament of five to the filament of eight cells. The sub-basal cell divides first to change the five-celled filament to a filament of six cells. Then a small triangular marginal mucilage cell is cut off at the outer part of the curve from the cell located third from the distal end, and mucilage is seen to be forming in the sub-terminal cell. Finally a larger triangular marginal mucilage cell is cut off from the latter cell at its outer side. The marginal mucilage cell is quite similar to that described in the gemma (5). Of the eight cells thus formed, only five are normal chlorophyllose cells, and one of these is the attachment cell. Although the two marginal mucilage cells have been cut off on one side, the structure should still be called a filament rather than a plate of cells. Two days after fig. 11 was made, no further changes were noted except a slight increase in length of some of the cells. Our cultures deteriorated rapidly.

The papillose mucilage cell usually becomes displaced by an overgrowth of the sub-terminal cell or cells. The phenomenon is quite comparable with the displacement of the papillose mucilage cell of the gemma except that this cell of the ventral scale is not as uniformly displaced to the under surface of the scale; it is often crowded as much to one side (figs. 7, 17) as underneath (figs. 12, 14). The overgrowth may begin in the three-celled filament but usually is not pronounced until much later. The size of this cell also varies considerably; in some instances it remains relatively small while in others it becomes very large, lobed, and unevenly thick-walled, much as its homologue in the gemma. Usually the mucilage is concentrated into one to three centrally located masses; much more rarely it is found scattered in numerous small drop-like masses (figs. 12, 16). Its nucleus often remains clearly visible and chloroplasts continue to be absent.

When the ventral scale is three to eight cells long, the filament begins to broaden into a cell plate by the formation of cross walls perpendicular to those first laid down, that is, parallel with the long axis of the scale. The sub-basal cell is usually the first to divide and divisions progress toward the apex (figs. 13, 14, 17). The change

from filament to cell plate takes place earlier in ventral scales on older plants than in those on gemmalings. When composed of six to twelve cells in the form of a two-rowed cell plate, some of the ventral scales on older plants have nearly all of their cells enlarge to an enormous size; they may become rounded, loosely connected with one another, and stand out at unexpected angles (fig. 15). The fate of these particular ventral scales is unknown; they do not seem to reach maturity. The pronounced variations in shape of the young cell plate, as well as of the older ventral scale contrast sharply with the uniformity found in the gemma (5).

In all ventral scales in the early cell plate stages, the cells of the distal part are larger than those of the proximal.

Marginal mucilage cells usually appear much earlier in ventral scales found on the gemmaling; ventral scales on older plants usually do not show them until the cell plate is at least in part two cells broad and about six cells long (figs. 16, 17). They are not numerous in the early cell plate stages.

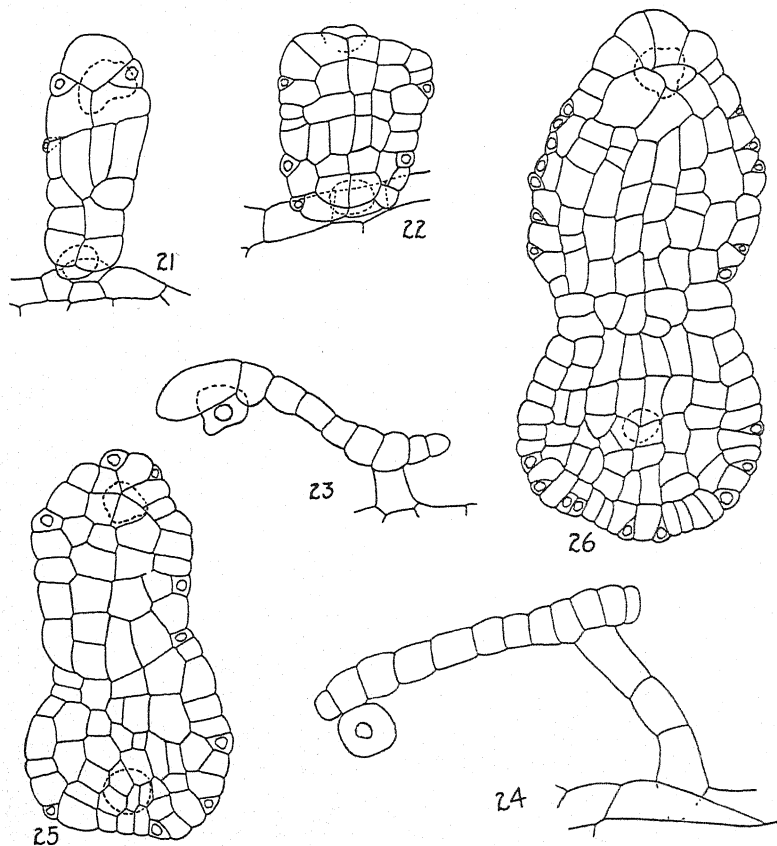
The method of overgrowth of the attachment cell by the sub-basal cells (fig. 18) and of the papillose mucilage cell by the sub-terminal cells (figs. 19, 20, 21, 23) is identical with that found at both base and apex in the gemma (5). The papillose mucilage cell may remain of an immense size (fig. 19). The attachment may be composed of a single cell (figs. 19, 23), a short filament of two cells (fig. 21), or a longer filament of several cells (fig. 24); the first is the more common.

As the ventral scale approaches maturity, marginal mucilage cells become more numerous, and the shape of the scale varies greatly. Sometimes a broad isthmus is formed across the middle as a result of more rapid growth in width toward both ends (figs. 19, 20, 25, 26). At other times there is no indication of an isthmus (fig. 22).

The mature ventral scale of *Riella americana* (fig. 26) is very irregular in shape; it is often panduriform with a broad isthmus and equal or unequal lobes, or oblong, or more rarely obovate or ovate. The margin is entire or shallowly crenate. The base and apex are broadly acute or obtuse, or rarely emarginate. Its length ranges from 220 to 540  $\mu$  with an average of about 310  $\mu$ . Its width averages about 160  $\mu$  with a range of 100 to 350  $\mu$ .

Even at maturity, the ventral scale is unistratose; only the attachment cell and the papillose mucilage cell are found underneath the cell plate. Marginal mucilage cells are abundant, about twenty being a rather common number.

The papillose mucilage cell is commonly found on the under surface of the mature ventral scale, one or two cells removed from the tip.



Figs. 21-26. *RIELLA AMERICANA*,  $\times 175$ . Mucilage is shown diagrammatically by a wavy line, which is not indicative of its true shape, especially in the papillose mucilage cell. When overgrown by the cell plate, papillose mucilage cell and attachment cell are shown with dotted lines. 21. Ventral scale in slightly older stage than shown in fig. 20; from an older plant. 22. Short and broad ventral scale, without an isthmus; from an older plant. 23. Lateral view of ventral scale approaching maturity, showing growth of cell plate over both attachment cell and papillose mucilage cell; from an older plant. 24. Same with a filament of basal cells; cell plate of scale six cells wide at attachment and eight cells wide toward apex; from an older plant. 25. Nearly mature ventral scale, with poorly defined isthmus; from an older plant. 26. Mature ventral scale.

It varies considerably in size. The attachment also occurs on the under surface, four or five cells removed from the proximal end of the proximal lobe; it may be composed of a single cell, often of a short

filament of cells, or more rarely of a filament ending below in a broadened base of two to four cells.

Chloroplasts are present in all cells except the mucilage cells. The ventral scale is, however, a much lighter green than the gemma, since the chloroplasts are more widely separated.

The mature ventral scale is attached fifty or sixty degrees tangentially around the axis back from its middle ventral line. It usually stands in the same plane as the wing, with its apex pointing ventrally beyond the front of the axis. Hence, when the entire plant is seen from the side, one has a top view of all of those ventral scales as well as of those gemmae which are fastened to one side of the axis.

#### HOMOLOGY OF SCALES AND GEMMA

The ventral scale resembles the gemma in that both originate on the ventral face of the axis and are found in progressively older stages from the middle ventral line around its surface for fifty or sixty degrees on either side; they originate from a single cell; they pass through a filamentous stage in their development which later becomes a unistratose cell plate; they are generally attached by a single cell which is soon covered by a backwards overgrowth of the cell plate; they have a prominent mucilage cell which is first terminally located and which later is overgrown by the cell plate; when mature, they have the same orientation on the axis; both are green; and one is often and the other always panduriform at maturity.

The ventral scale differs from the gemma in that the former may be produced early on young gemmalings; it is found further down on the axis than the gemmae on older plants; its first cross walls occupy an oblique position; its papillose mucilage cell is recognizable as such several cell generations earlier; it is smaller and has a different shape; its cells are nearly always appreciably larger and less densely green; and it has no definite function, except photosynthesis, while the gemma is responsible for vegetative propagation.

The ventral scale is similar to the lateral leaf scale in that they originate from a single cell, pass through a filamentous stage, later form a unistratose cell plate, have their body remain one cell thick to maturity, have large cells, and possess a light green color.

The two types of scales differ from each other in size, in their location and orientation on the axis, in function, in the orientation of their first cross walls, in the shape and size and number of cells com-



posing the base, in the character of the apical mucilage cell, and in the position occupied by both base and apical mucilage cell at maturity of the scale.

The lateral leaf scale resembles the gemma in that both originate from a single cell; the first cross walls occupy a similar position; they pass through a filamentous stage which soon becomes a plate of cells; the body of both remains unistratose; and both possess for a time a terminally situated mucilage cell.

The lateral leaf scale differs from the gemma in shape and size, in location and orientation on the axis, in the intensity of its green color, in the size of its cells, in the character of the terminal mucilage cell, in the nature of the base, in the position of the once terminal mucilage cell and of the base at maturity, and in its function. The mature lateral leaf scale varies more pronouncedly from the gemma than does the ventral scale from either of these.

One is struck by the similarities which are found in all three of these appendicular structures. Running through both types of scales as well as the gemma are the following major points of likeness: their first origin on a young plant is near the major growing zone at the top of the axis; all have their origin from a single surface cell; all pass through a filamentous stage which later becomes a plate of cells only one cell in thickness; the attachment usually remains a single cell for a period of time; all possess a prominent mucilage cell which retains for a variable time a terminal position; all possess identical marginal mucilage cells; the body of each is unistratose at maturity; all of their cells except the several mucilage cells are supplied with chloroplasts throughout their ontogeny from the primordium to maturity; and all are appendicular structures.

Such differences as exist—and they are numerous enough—are mostly of a minor nature, or else are found toward and at maturity of scale or gemma.

That these structures are homologous to one another in so far as the genus *Riella* is concerned, there can be little doubt. The present writers also believe that the ontogenetic evidence is very strongly indicative of the theory that all three structures had their origin in some kind of a mucilage hair. Scales and mucilage hairs are produced most abundantly in the major growing regions of liverworts. For the genus *Riella*, they follow the general ideas of homology laid down by Goebel (3), Cavers (2), and Vraber (7), all of whom, however, con-

sidered only one kind of scale. Buch (1) also considers scale and gemma closely related in *Riella*. Herzog (4), on the other hand, without considering *Riella* specifically, does not believe in the homology of mucilage hairs and certain other structures in the liverworts.

In the present paper, then, homology is extended forward to include both types of scales; and it is extended backward on purely theoretical grounds to the possible derivation of the mucilage hair from a surface mucilage cell (this latter, however, is not applicable to *Riella*).

A hypothetical phylogenetic sequence may, therefore, begin with a surface mucilage cell. One line of development from such a cell has resulted in the marginal mucilage cells, which differ from their progenitors in having a more restricted position on the plant. The other line has resulted in the mucilage hair. From the latter originated a simple scale, which later became varied into two types, lateral leaf and ventral scales. And lastly, the gemma differentiated from the ventral scale, assuming the specialized function of vegetative propagation. This idea of homology is encumbered with two weaknesses: 1) there are no mucilage hairs in *Riella*, and 2) it does not take into account a possible homology between gemma and spore.

#### SUMMARY

The ventral scale of *Riella americana* originates from a single surface cell. The first division cuts off a terminal mucilage cell which later becomes papillose. By division of the basal cell, a filament of three cells is formed. Further growth comes from the intermediate cell, which produces first an elongation of the filament and later a cell plate. Attachment cell and papillose mucilage cell remain undivided and usually become displaced ventrally by growth of the cell plate over and beyond them. At maturity, the cells are large, marginal mucilage cells are abundant, and a broad isthmus is often present near the middle.

Both types of scales, as well as the gemma, are considered to be homologous structures.

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## SAINSBURIA, A NEW GENUS OF FISSIDENTACEAE

H. N. DIXON

Pusilla, habitu specierum *Fissidentis* Sectionis *Heterocaulon*. Caules dimorphi, steriles plumosi, fructiferi paucifolii brevissimi. Fructus terminalis; theca erecta, minuta. Peristomium infra orem oriundum; dentes 16, aut subintegra aut linea media superne rimosi; inferne tenerime papilloso, superne leniter longitudinaliter striolati.

### *Sainsburia novae-zealandiae* Dix. nov. gen. et sp.

Gregaria, cum *Fissidente Taylora* commixta. Caulis sterilis 3-4 mm. altus, plumosus, densifolius, plurijuga; folia erecto-patula, haud patentia, circa 1 mm. longa, inferiora latiuscule, superiora anguste ovato-oblonga, acuta, subpellucida, integra. Lamina vaginans tantum marginata, limbidio angusto, pallido, tenero. Costa validiuscula, concolor, percurrents, haud excurrens. Cellulae majusculae, 8-10  $\mu$  latae, hexagonae, chlorophyllosae, perdistinctae, pellucidae, parietibus angustis, firmis; basilares breviter rectangulares.

Flos ♂ in ramo brevissimo ad basin caulis sterilis et fructiferi situs, paucifolius.

Planta fructifera perbrevis, folia 3-4-juga; inferiora e basi late ovali raptim rigide cuspidata, peracuta, costa valide excurrente, lamina dorsali perangusta, angustissime defluente; superiora raptim mutata, e basi dilatata longe lanceolata, acuta, costa percurrente; cellulis paullo laxioribus, saepius elongato-hexagonis.

Seta 4-5 mm. longa, pallide rubra, theca erecta, elliptico-urceolata, 1 mm. longa, sub ore coarctata, pallida, leptodermica; exothecii cellulae laxae, latae, irregulariter late rectangulares, angulis rotundatis, parietibus incrassatis sed mollibus; apud orem minoribus, subquadratis. Stomata apud basin thecae, male evoluta. Peristomium longe infra orem positum, pulchre rubrum; dentes bene evoluti, .25 mm. longi, lanceolati, latiuscule acuti, infra cohaerentes; supra sensim, saepe irregulariter angustati, inferne integri, superne linea media rimosi; infra papilloso, apud apices plus minusve distincte striolati; sat remote trabeculati, trabeculis circa 20, dorsali altiuscule, ventraliter minime prominentibus. Spori 18-22  $\mu$ . Operculum conicum, brevissime curvirostellatum.

Hab. On damp, sandy, shaded soil, Whakaki Lagoon, near Wairoa, Hawkes Bay, New Zealand; 23 July, 1939; coll. G. O. K. Sainsbury (1960).

A highly interesting little plant, with the habit of *Fissidens Taylori* C. M., with which, curiously enough, it was growing. (The *Fissidens* can at once be distinguished by the curved capsules, as well as by the bordered leaves.) Not only are the stems dimorphous, as in that, but the leaves of the fertile stems are similar, in having only the ventral side well developed, the dorsal lamina being reduced to a very narrow strip, especially in the lower part of the leaf.

The important character is of course the structure of the peristome teeth. These somewhat recall *Trematodon* in being generally undivided both at base and at the extreme tip, while rimose or split along the median line for some distance in the upper part. They are papillose below, while in the upper part more or less distinctly longitudinally or obliquely striolate. Both in form and sculpturing they show a rather notable variability.

The genus is perhaps nearest to the South American *Simplicidens* Herz., but there the teeth are undivided, and papillose only.

I have named it after the collector, who has not only done much to add to our knowledge of the highly interesting moss flora of New Zealand, but has stimulated interest in its study among many new workers.

It may be useful to give a key to the genera of the Fissidentaceae, of which until recently *Fissidens* and *Moenkemeyera* were the only two known, and to which in the last few years three new genera have been added.

#### FISSIDENTALES

ARCHIFISSIDENTACEAE. Protonema persistent, sometimes becoming thalloid by the fusion of the filaments. Stems not dimorphous. Leaves as on the fertile stems of *Fissidens* § *Heterocaulon*. Areolation dicranelloid. Peristome teeth as in *Fissidens*, with spiral thickenings. . . . . *Nanobryum*  
FISSIDENTACEAE. Protonema normal. Areolation more or less isodiametric

Peristome teeth divided to near base. . . . . *Fissidens*  
Peristome teeth fugacious, not striolate nor spirally thickened, papillose, irregularly divided above. . . . . *Fissidentella*  
Peristome teeth not divided above

Teeth well developed, papillose; leaves bordered throughout. . . . . *Simplicidens*  
Teeth not well developed, entire, sometimes wanting, not striolate; leaves unbordered or only the vaginant lamina bordered. . . . . *Moenkemeyera*  
Teeth well developed, rimose above, entire below and at tips, striolate at apex. . . . . *Sainsburia*

RECENT MOSS COLLECTIONS FROM OHIO<sup>1</sup>

RICHARD T. WAREHAM

As a result of more or less intensive work during the past five years, this list of seventy species and varieties of mosses not heretofore reported from Ohio can be made. In addition to those collected by the writer, specimens have been contributed by other members of The Ohio State University Department of Botany staff and by many so-called amateurs. Of this latter group Mr. Floyd Bartley and Mr. Leslie Pontius of Circleville have contributed the greatest number of specimens. Most of their specimens were collected in Jackson County, although many are from Highland, Pickaway, Ross, Hocking, and Pike Counties.

Many of the species reported here are well within their range as stated in the literature. Others, such as *Amphidium californicum*, *Andreaea rupestris*, *Andreaea Rothii*, *Dichodontium pellucidum*, *Fissidens Garberi*, and *Pogonatum brachyphyllum*, represent considerable extensions of the known ranges.

In the list the distribution is given by counties. The name of each county is followed by the collector's name or abbreviation thereof and the packet number, if any. The date of collection is given if the packets are not numbered. Unless otherwise indicated, the number refers to the Herbarium of R. T. Wareham. The following names have been abbreviated as follows: Bartley and Pontius = B & P; A. J. Sharp = S; R. T. Wareham = W. All specimens are deposited in the Moss Herbarium at The Ohio State University.

The writer is indebted to A. J. Grout, A. L. Andrews, E. B. Bartram, Winona Welch, W. C. Steere, and A. J. Sharp for identification of some specimens and confirming his identifications of others.

AMBLYSTEGIUM JURATZKANUM Schimp. Ashland: *Yingling* 2385; Champaign: *W* 1102; Clark: *Taft* 2443; Franklin 5/11/29; Geauga: *W* 2519, 2558; Portage: *W* 2572; Richland: *W* 1145, 1153; Wilkinson, in herb. as *Campylium hispidulum* 3/31/92; Wood: *Shanks* 2188.

AMPHIDIUM CALIFORNICUM (Hampe) Broth. Hocking: *B & P* 1956, *W* 2403; Jackson: *B & P* 1337, *S* 1541.

AMPHIDIUM LAPPONICUM var. CRISPATUM (Kindb.) Grout. Jackson: *B & P* 565, 1954.

AMPHIDIUM MOUGEOTII (Bry. Eur.) Schimp. Hocking: *B & P* 820, 2221, 2223, *W* 2764, 2769; Jackson: *B & P* 792, 1404, 1953, 2243.

ANDREAEA ROTHII Web. & Mohr. Fairfield: *W* 855.

ANDREAEA RUPESTRIS Hedw. Hocking: *W* 2795.

<sup>1</sup> Papers from the Department of Botany, The Ohio State University. No. 431.

ATRICHUM MACMILLANI (Holz.) Frye. Licking: *W* 1260.

BARBULA REFLEXA (Brid.) Brid. Adams: *S* and *W* 916, 1034, 1863; Champaign: *S* 873.

BRACHYTHECIUM CAMPESTRE Bry. Eur. Trumbull: *Rood* 1658.

BRACHYTHECIUM FLEXICAULE Ren. & Card. Franklin: *W* 1519; Portage: *Rood* 1663; Ross: *B* & *P* 1360.

BRACHYTHECIUM OXYCLADON var. DENTATUM (Lesq. & James) Grout. Highland: *B* & *P* 561.

BRACHYTHECIUM RUTABULUM var. FLAVESCENS (Brid.) Bry. Eur. Shelby: *W* 1669.

BROTHERELLA DELICATULA (James) Fleisch. *H. C. Beardslee*, near Painesville, O., in 1879 (specimen labeled *Hypnum turfaceum* Lindb.).

BRYUM TORTIFOLIUM Funck. Shelby: *W* 1753.

CAMPYLIUM CHRYSOPHYLLUM var. BREVIFOLIUM (Ren. & Card.) Grout. Adams: *W* 1042; Highland: *B* & *P* 557, 1004; Hocking: *W* 2832; Jackson: *B* & *P* 970; Ross: *B* & *P* 2227.

CLASMATODON PARVULUS var. RUPESTRIS Sull. & Lesq. Highland: *B* & *P* 272; Hocking: *W* 2850; Jackson: *B* & *P* 2236; Ross: *B* & *P* 2235; Scioto: *S* and *W* 737, *W* 738; Shelby: *W* 1771.

CLIMACIUM KINDBERGII (Ren. & Card.) Grout. Ashtabula: *W* 2514; Crawford: *Horton*, 4/3/25; Delaware: *Blaydes*, 2/27/25; Franklin: *Coles*, in herb. as *C. americanum*, 1/7/33, *Gordon*, 12/12/31; Henry: *Shanks* 2197; Hocking: *B* & *P* 2219; Jackson: *B* & *P* 420, 617, 688, 1377, *W* 1524; Lake: *Werner*, in herb. as *C. americanum*, July, 1885; Licking: *Jones* 2818; Morrow: *Crowl* 238, *Porter* 919; Richland: *W* 178, 1175, 1486, 2104; Ross: *B* & *P* 1091; Scioto: *Chapman* 2257; Shelby: *Shanks* 2388; Stark: *Kellerman*, in herb. as *C. americanum*, 6/27/98; Trumbull: *Rood* 1676; Williams: *Fernholz* 723.

CRATONEURON COMMUTATUM (Hedw.) Roth. Ross: *B* & *P* 63.

DICHELYMA CAPILLACEUM Bry. Eur. Jackson: *B* & *P* 402; Ross: *B* & *P* 673A, 1330.

DICHODONTIUM PELLUCIDUM (Hedw.) Schimp. Ashtabula: *W* 2644, 2666.

DICRANELLA SCHREBERI var. ELATA Schimp. Ross: *B* & *P* 1797.

DICRANUM CONDENSATUM Hedw. Adams: *Yingling* 2301, *Braun*, 5/15/37; Hocking: *W* 2426; Jackson: *B* & *P* 534, 861, 1398, *W* 1837.

DICRANUM DRUMMONDII C. Muell. Fairfield: *Werner*, in herb., as *D. Bonjeani*, 9/3/91.

DIDYMODON TOPHACEUS (Brid.) Jur. Adams: *S* 1564; Shelby: *S* and *W* 782; Lake: A specimen in New York Botanical Garden originally labeled *Trichostomum rigidulus* and corrected to *D. tophaceus* by Mrs. Britton.

DREPANOCLADUS ADUNCUS var. KNEIFFII (Bry. Eur.) Warnst. Clark: *Spence*, in herb. as *D. aduncus*; Franklin: *Blaydes* 830, 1199; Jackson: *B* & *P* 667; Licking: *Jones* 2817.

DREPANOCLADUS ADUNCUS var. POLYCARPUS (Bland.) Warnst. Franklin: 5/19/29; Logan: *S* 1823; Pickaway: *B* & *P* 547; Ross: *B* & *P* 2015; Shelby: *Shanks* 2390.



DREPANOCLADUS EXANNULATUS (Guemb.) Warnst. Adams: *Fulford*.

DREPANOCLADUS INTERMEDIUS (Lindb.) Warnst. Champaign: *Werner*, in herb. as *Hypnum scorpioides*, *B & P* 2480; Ross: *B & P* 1826, 1828.

DREPANOCLADUS VERNICOSUS (Lindb.) Warnst. Ohio (definite location unknown): in New York Botanical Garden from Torrey Herbarium as *Hypnum aduncum*??, 1842?

ENCALYPTA STREPTOCARPA Hedw. Adams: *W* 1050, 1064, *S* 1555; Greene: *W* 2318; Highland: *B & P* 558.

EURHYNCHIUM STRIGOSUM var. ROBUSTUM Röhl. Hamilton: *Bauer*, in University of Cincinnati Herb. as *Eurhynchium diversifolium*; Pickaway: *B & P* 2154; Ross: *B & P* 1092.

FABRONIA CILIARIS (Brid.) Brid. Jackson: *B & P* 2475; Ross: *B & P* 2421; Pickaway: *B & P*, 11/28/37.

FABRONIA RAVENELLII Sull. Ross: *B & P* 2484.

FISSIDENS GARBERI Lesq. & James. Hocking: *W* 2903; Jackson: *W* 1847.

FISSIDENS VIRIDULUS (Web. & Mohr) Wahlenb. Adams: *S* 1568.

FONTINALIS MISSOURICA Card. Franklin: Conservation field crew, 2173.

FONTINALIS NOVAE-ANGLIAE var. LATIFOLIA Card. Adams: *Gordon*; Brown: *Braun* 2822; Hocking: *W* 2814, 2821; Jackson: *B & P* 812, 1399; Portage: *Brown*, *Brown M* 39.

GRIMMIA APOCARPA var. GRACILIS (Schleich.) Web. & Mohr. Jackson: *B & P* 810; Scioto: *W* 743.

GYMNOSTOMUM RECURVIROSTRE var. SCABRUM Lindb. Adams: *Fulford*; Greene: *W* 2296.

HYPNUM PATIENTIAE var. ELATUM Schimp. Champaign: *S* 2137.

LEPTODICTYUM TRICHOPODIUM (Schultz) Warnst. Champaign: *W* 1635; Franklin: *Werner*, in herb. as *Amblystegium adnatum*, 5/12/92; Highland: *W* 1480; Jackson: *B & P* 527; Lake: *Beardslee*, in herb. as *Hypnum riparium*; Madison: *W* 2331; Miami: *W* 1747; Muskingum: *Popham* 867; Pickaway: *B & P* 1082; Richland: *W* 1201, 1202; Scioto: *W* 1584; Shelby: *W* 1623; Trumbull: *Rood* 1654.

LEPTODICTYUM TRICHOPODIUM var. KOCHII (Bry. Eur.) Broth. Hardin: *Shanks* 2264, 2266; Pickaway: *B & P* 374; Richland: *W* 1161.

LESKEA GRACILESCENS Hedw. Adams: *W* 974; Clark: *Taft* 2806; Delaware: *Blaydes* 731; Fairfield: *Blaydes* 1020; Franklin: *W* 1246, *Chapman*, in herb. as *L. polycarpa*, 7/31/32, *Coles*, in herb. as *L. polycarpa*, 1/18/33, 6/2/33; Jackson: *B & P* 627; Licking: *W* 1257, 1305; Madison: *Taft* 2753; Richland: *W* 1505; Ross: *B & P* 2159; Sandusky: *W* 2399; Williams: *Fernholz* 460.

LEUCODON SCIUROIDES (Hedw.) Schwaegr. Franklin: *Coles*, in herb. as *L. julaceus*, 1/19/33; Greene: *W* 2314, 2330; Highland: *B & P* 572; Miami: *W* 1598; Pickaway: *B & P* 1013.

LINDBERGIA BRACHYPTERA var. AUSTINII (Sull.) Grout. Franklin: *W* 2253, 2294; Greene: *W* 2329; Hardin: *Shanks* 2268; Morrow: *W* 2731; Ross: *B & P* 699, 1990; Sandusky: *W* 2397.

NANOMITRIUM AUSTINII (Sull.) Lindb. Jackson: *W* 2416.

NANOMITRIUM SYNOICUM (James) Lindb. Jackson: *W* 2417.

ORTHOTRICHUM ELEGANS Hook. & Grev. Highland: *B & P* 2241; Lake: *Hacker*, in packet with *O. stellatum*, 1/21/94.

ORTHOTRICHUM OBTUSIFOLIUM (Schräd.) Brid. Lake: *Hacker*, in packet with *O. stellatum*, 1/21/94; Sandusky: *W* 2396.

ORTHOTRICHUM PUMILUM Dicks. Champaign: *W* 1099, 1100, 1104, 1633; Delaware: *W* 2340, *Blaydes* 332; Franklin: *W* 2254, 2293, *Blaydes* 701; Hardin: *Shanks* 2267; Hocking: *W* 2408; Lake: *Hacker*, in packet with "*O. strangulatum Beauv.*," 1/21/94; Licking: *W* 2796; Logan: *Sharp* 1822; Madison: *W* 2310, *Taft* 2735; Morrow: *W* 2727; Richland: *W* 1142, 1509; Ross: *B & P* 271, 2158; Sandusky: *W* 2395; Shelby: *W* 1600, 1817; Union: *Taft* 2496, *W* 1622, *Wolfe* 874.

ORTHOTRICHUM PUSILLUM Mitt. Madison: *W* 2311; Scioto: *W* 745.

ORTHOTRICHUM SORDIDUM Lesq. & James. Ohio (definite location unknown): in Miss Biddlecomb's collection "from Prof. Lesquereux", labeled *O. ohioense*. No other data.

PHASCUM CUSPIDATUM var. AMERICANUM Ren. & Card. Pickaway: *B & P* 2717.

PHILONOTIS CAESPITOSA Wils. Jackson: *W* 1207; Licking: *W* 1306.

PHILONOTIS MARCHICA (Willd.) Brid. Champaign: *Spence*, in packet with *Pohlia Wahlenbergii*, 5/4/77; Trumbull: *Rood* 1096.

PLAGIOTHECIUM ELEGANS (Hook.) Sull. Ashtabula: *W* 2625; Hocking: *W* 2788; Jackson: *W* 506, 511, *B & P* 651, 686, 1349; Portage: *W* 2579, 2602.

PLAGIOTHECIUM LAETUM Bry. Eur. Champaign: *Werner*, in herb. as *P. pulchellum*, 9/10/92; Fairfield: *W* 2504; Jackson: *W* 1838; Portage: *W* 2553, 2562; Scioto: *W* 1777; Trumbull: *Rood* 104.

PLAGIOTHECIUM LATEBRICOLA (Wils.) Bry. Eur. Jackson: *W* 1548; *B & P* 2336.

PLAGIOTHECIUM STRIATELLUM (Brid.) Lindb. Champaign: *Spence*, in herb. as *Hypnum chrysophyllum*, 6/1/91; Jackson: *B & P* 706, 1339, 1386, 1415, *W* 1545; Portage: *Rood* 100, *Rood* 129; Trumbull: *Shanks* 853.

POGONATUM BRACHYPHYLLUM (Rich.) Beauv. Hocking: *W* 2763, 2782.

POLYTRICHUM JUNIPERINUM var. ALPESTRE Bry. Eur. Champaign: *W* 1105, 1111; Licking: *Wilson* 2848; Portage: *Rood* 2455; Richland: *W* 139, 1155, 1172.

SCIAROMIUM LESCURI (Sull.) Broth. Hocking: *W* 2765, 2839, 2840, 2899; Jackson: *W* 1550, 1852, *B & P* 858, 1400.

RHACOMITRIUM HETEROSTICHUM var. SUBETICUM (Funck) Jones. Fairfield: *W* 897; Hocking: *W* 2431, 2498, 2761.

SEMATOPHYLLUM CAROLINIANUM var. ADMIXTUM (Sull.) Grout.

Ashland: *Yingling* 2384; Ashtabula: *W* 2688; Athens: *W* 1448; Fairfield: *Porter* 935; Hocking: *W* 433; Jackson: *W* 507, *B* & *P* 859; Portage: *W* 2547; Richland: *W* 1119; Ross: *B* & *P* 421; Scioto: *W* 1792, 1811; Vinton: *W* 1431.

*THELIA LESCURI* Sull. Lucas: *Lampton* 493, *B* & *P* 2492.

*TORTELLA TORTUOSA* (Turn.) Limpr. Highland: *B* & *P* 368; Hocking: *W* 2770.

*TORTULA PAPILLOSA* (Muell.) Wils. Adams: *B* & *P* 2298; Campaign: *B* & *P* 2476; Clark: *W* 2305; Franklin: *Blaydes* 2337, 2501, *W* 2295; Greene: *W* 2321; Licking: *W* 2797; Madison: *W* 2307, 2313; Morrow: *W* 2728; Pickaway: *Ikenberry*, 5/14/33, *B* & *P* 1975, 2203; Ross: *B* & *P* 699, 1987, 1988, 1989, 2155.

*TRICHOSTOMUM CYLINDRICUM* (Bruch) C. Muell. Hocking: *B* & *P* 819, 2217, 2222, 2224; Jackson: *W* 1843, *B* & *P* 877, 1977.

*WEISIA VIRIDULA* var. *AUSTRALIS* Aust. Scioto: *S* 2148.

*ZYGODON VIRIDISSIMUS* (Dicks.) Brown. Jackson: *W* 1552.

## THE STATUS OF *MARCHANTIA DOMINGENSIS*

RUTH DOWELL SVIHLA

While examining hepatics collected by Dr. and Mrs. T. C. Frye in Mexico during 1938 and 1939, I found material which appeared intermediate between *M. papillata* and *M. domingensis*. This led to the examination of a number of specimens of both these species with the result that *M. domingensis* is referred to *M. papillata* as a synonym with the combined descriptions, synonymy and distribution of the two.

Evans<sup>1</sup> retains *M. papillata* and *M. domingensis* as separate species although he states that the differences are in many cases slight and that "if they should be found to intergrade it might be necessary to reduce *M. domingensis* to synonymy under *M. papillata* . . ." He differentiates between the two as follows:

*M. papillata*. Thallus 1.5–3 mm. wide; epidermal cells 30 x 15  $\mu$ ; epidermal pores 40–45 x 50–70  $\mu$ ; female disc with low median protuberance; apices of the lobes of the female receptacle dilated, usually emarginate; involucre entire to crenulate.

*M. domingensis*. Thallus 4–6 mm. wide; epidermal cells 45 x 23  $\mu$ ; epidermal pores 70–80 x 90–130  $\mu$ ; female disc with no median protuberance; apices of the lobes of the female receptacle not dilated or emarginate; involucre crenulate to ciliate.

<sup>1</sup> Evans, A. W. The American species of *Marchantia*. Trans. Conn. Acad. Arts & Sci. 21: 284–286. 1917.

The comparable characters of Fries' 2905 are: Thallus 3-4 mm. wide; epidermal cells  $37 \times 17 \mu$ ; epidermal pores  $69 \times 77 \mu$ ; female disc with no median protuberance; apices of the lobes of the female receptacle dilated, usually emarginate; involucre crenulate to slightly ciliate.

Taking the above characters as diagnostic, Fries' 2905 agrees more closely with *M. papillata* in the size of the epidermal cells and the dilated, usually emarginate apices of the lobes of the female receptacle. It agrees with *M. domingensis* in having no pronounced median protuberance to the female disc. It appears to be intermediate in the size of the thallus, the size of the epidermal pores and the crenulate to slightly ciliate involucre. Hence it is an intermediate form between *M. papillata* and *M. domingensis*.

Material of *M. domingensis* was studied from Texas, Louisiana, Florida and Puerto Rico. The specimens from Texas, Louisiana and Florida showed greater affinity to the characters designated for *M. domingensis* than for *M. papillata*. The Puerto Rico material, however, was intermediate in thallus width and in the size of the epidermal cells and pores. Unfortunately this material was sterile, so that no diagnosis of the female receptacle could be made.

Through the courtesy of the New York Botanical Garden, specimens of *M. papillata* were examined from Bolivia, Brazil, Paraguay and Peru. The characters upon which these two species are separated were studied and in each case an average of ten measurements was made of the thallus, epidermal pores and epidermal cells. The thallus widths of the *M. papillata* material agreed more closely with those designated for *M. papillata* than for *M. domingensis*. The measurements of the epidermal pores overlapped those given for these two species. The sizes of the epidermal cells corresponded with those given for *M. domingensis*. The prominence of the low median protuberance on the disc of the female receptacle as well as the convexity of the upper surface seemed to be correlated with the age of the sporophyte, for on young specimens the protuberances and the convex surfaces were quite evident while on the older receptacles the discs lacked protuberances and the surfaces were flat. The apices of the lobes of the female receptacles varied as to the degree of dilation and emargination. In some cases only two out of five lobes on a receptacle were dilated or emarginate. On account of the age of the specimens,—some having been collected as early as 1883—it was difficult to secure

good mounts of the delicate involucre. Those which were mounted successfully had entire to crenulate margins. Thus the characters which separate these two species were found to overlap to a marked degree even in material other than Fries' collection.

The geographic distributions of these two species, as heretofore recognized, meet and overlap in the West Indies. *M. domingensis* has been considered a North American species which barely gets into northern South America while the South American species, *M. papillata*, reaches into the West Indies.

Specimens are reported from the Falkland Islands, Paraguay, Bolivia, Peru, Brazil, Martinique and Cuba as *M. papillata* (Evans, l. c.); and from Florida, Georgia, Alabama, Tennessee, Arkansas, Oklahoma, Texas, Mexico, Guatemala, Bahamas, Cuba, Jamaica, Santo Domingo, Puerto Rico, St. Kitts, Montserrat, Guadeloupe, Dominica, Martinique, St. Vincent, Grenada, Trinidad, Venezuela as *M. domingensis*.<sup>2</sup>

The Fries' material was gathered as follows: VERA CRUZ: Córdoba, on clayey bank, about 10 km. westward along road to Orizaba, altitude about 1000 m. (2905), Aug. 7, 1938. NUEVO LEÓN: Santiago, on wet soil just at the base of Horsetail Falls and somewhat in its spray (2674), Apr. 25, 1939. HIDALGO: Chapulhuacan, on clay bank about 5 km. southward along the highway, altitude about 2000 m. (2852), May 24, 1939.

Previously reported from the following states in Mexico by Gottsche<sup>3</sup> and by Evans (l. c.): VERA CRUZ: near Santa María Tlapacoyo; Mt. Orizaba; Orizaba and vicinity; Córdoba. HIDALGO: Tula. PUEBLA: Tezuitlan. TAMAULIPAS: near Victoria.

In conclusion, it is evident that the characters designated to separate *M. domingensis* from *M. papillata* do not hold true since specimens individually show characters of either or both species. This evidence together with that of the intermediate position of Fries' 2905 and the overlapping distribution of the two species is considered sufficient reason for reducing *M. domingensis* to synonymy under *M. papillata*.

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<sup>2</sup> Frye and Clark. Hepaticae of North America. Univ. of Wash. Publ. Biol. 6: 102. 1937.

<sup>3</sup> Gottsche, C. M. De Mexikanske Levermosses. Dansk. Vid. Selsk. Skrift. 6: 364. 1867.

## A NOTE CONCERNING PSORA OSTREATA

In December, 1939, the writer discovered plentiful fertile specimens of *Psora ostreata* Hoffm. (*Lecidea ostreata* (Hoffm.) Schaer.) on the bark of a white pine in High Point Park, N. J., at about 1500 feet elevation. This represents a southward extension of range of several hundred miles. Specimens were deposited in the Farlow Herbarium, where Dr. David H. Linder confirmed the determination.

Actually, the sterile lichen appears to be well represented in this region on bark or dead wood of *Pinus Strobus*, *P. rigida*, *Quercus Prinus*, etc., especially where scorched by fire, but its resemblance, when not in fruit, to *Psora anthracophila* and *P. Friesii* is so close that few would care to name it in that condition. *P. Friesii* is very similar, but the disk is more closely adnate, the exciple thinner, the spores smaller, and many squamules tend to cling closely, concealing their under surface, instead of projecting in the manner of *P. ostreata*. *P. anthracophila* presents no constant observable difference when sterile, but the apothecia, found a number of times in this district and in the pine barrens, are wholly different, bright brown instead of black, strongly convex and rough instead of flat and smooth. All three species are characterized by a fondness for charcoal, and by growing far up the trunks of exposed trees. They can be differentiated from *Cladonia caespiticia* by their smaller squamules, less densely massed, projecting more downward than outward, and by their entire rather than crenate margins.—G. G. NEARING.

## THE FORAY OF 1940 AT OHIO PYLE, PENNSYLVANIA

ELIZABETH CHAVANNES

Although the number of participants fluctuated from day to day, the total was 23, the largest attendance at any of the five annual forays of the Society. The choicest collection was perhaps that of *Hookeria acutifolia*, a moss reported only once before from Ohio Pyle, in 1917, from still another station. *Polytrichum piliferum*, found beside a boulder near a creek, is rare in that region. To those whose acquaintance with *Webera sessilis* and *Buxbaumia aphylla* had been limited to highly desiccated herbarium specimens, it was a great satisfaction to find the two mosses in good fruiting condition in expanses measuring whole square feet.



The choice of Ohio Pyle for the foray was a happy one, for not only was a rich assortment of mosses and liverworts there for the finding, but the leader of the foray was Dr. O. E. Jennings, long familiar with the mosses of southwestern Pennsylvania. As a check list, Dr. Jennings provided a record of the mosses, hepatics and lichens from the Ohio Pyle region which have thus far been placed in the classified collections of the Carnegie Museum in Pittsburgh. Of seventy-five mosses on the check list, sixty and probably twenty-five additional species were found; of twenty-one hepatics, fifteen and probably six additional ones. Unfortunately the lichens were rather consistently neglected by all those collecting.

Although a good many of the party gathered at the hotel in Ohio Pyle Friday night, the twenty-second, the occasion was only one of becoming acquainted and making plans for the expeditions of the weekend. During the three days of the foray, four localities were explored in some detail.

Saturday morning was devoted to working along the banks of the Youghiogheny River and its falls and a wooded hill caught in a bend of the river, all with essentially east and south exposures. Saturday afternoon was spent at and around Cucumber Falls and along the dripping cliffs and wooded slopes of the valley of Cucumber Run where this little tributary enters the Youghiogheny.

Sunday was given over to an all day trip up another rocky little river, Meadow Run. It was this expedition that yielded the *Hookeria* and that, despite persistent searching and abundant collection of sterile material, failed to yield fruiting *Fontinalis*.

Monday morning found the party heavily depleted by the calls of business and summer school, but those left collected for some distance along the river, to a station for *Magnolia tripetala*. That afternoon the foray had dwindled essentially to Dr. and Mrs. Jennings and Dr. Conard's group from Grinnell. Even so, collecting was continued along the country lanes south of Ohio Pyle, until the mugginess of the previous three days culminated in a drenching storm and the foray was officially terminated.

The accommodations at the hotel were pleasant, and the group was extremely congenial. Dr. Jennings' leadership relieved the foray of much of the aimless wandering that is likely to accompany collecting in a strange territory. The green wooded hills were appealing for reasons other than their mosses, since the azaleas were just going out

of bloom and the rhododendrons just coming in. The mosquitoes were never so large that self defense became an acute problem. Collecting was excellent, but one could wish that time had permitted collecting in habitats a little more varied, since each day carried the party into yet another cool, damp valley with heavily wooded slopes and an occasional dripping cliff. Many choice areas are within walking distance of the hotel. An exhaustive study of *Atrichum* in this region would clarify the speciation and variation in this genus.

That the foray was successful was attested by the fact that every participant left with the same question, "Where are we going next year?"

NOTE—In answer to the question terminating Miss Chavannes' account of the 1940 Foray, the Sullivant Moss Society Foray for 1941 will be in the vicinity of Natural Bridge State Park, Powell County, Kentucky (not Virginia), near the first of September. Details will be announced later.—H. S. CONARD, Vice-President.

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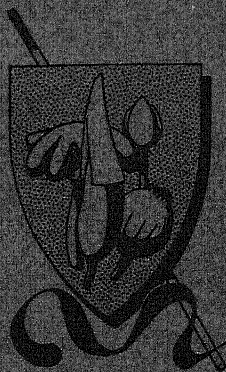
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JUNE, 1941

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## THE EXAMINATION OF LICHENS BY SMEARS PREPARED IN THE FIELD

G. T. JOHNSON\* AND WILLIAM L. BROWN

Lichens have always been regarded as difficult plants to prepare for microscopic examination. Although they are very soft when saturated with water, their tissues are so hard when desiccated as to be impervious to the infiltrating agents of most techniques. The latter fact is particularly noticeable when attempts are made to prepare sections from lichen material embedded in paraffin. Lichens, therefore, are ordinarily studied from freehand sections mounted in lactophenol, glycerine, or some similar preparation. Usually herbarium material alone is available for study, but since dried material of considerable age resembles a living specimen when moist this technique is satisfactory for the gross morphological study of a species.

Developmental and cytological studies, however, require more than freehand sections of material that has been stored in cases for a period of years. Living material must be adequately fixed, sectioned, and stained. Sectioning is difficult regardless of whether the material is embedded in paraffin, celloidin, or low-viscosity nitrocellulose, and serial sections are rarely possible except with the paraffin method. Furthermore, lichens grow so slowly that large samples of material must be collected and many slides prepared to obtain all stages in their development (laborious by any method). In an attempt to avoid many of these technical difficulties the writers have endeavored to supplement the study of slides made by other methods by the examination of smears prepared in the field. Several genera were

\* Fellow of the John Simon Guggenheim Memorial Foundation.



examined in this way without yielding data other than that which could have been obtained from the examination of freehand sections alone. Species of *Pertusaria*, *Ocellularia*, and *Thelotrema*, however, have apothecial characteristics which make possible a more favorable report, details of which are recorded below.

Species of *Pertusaria*, *Ocellularia*, and *Thelotrema* possess apothecia whose contents, although just as hard as the thallus when dry, swell greatly and are softer than the thallus when moist. The contents of each apothecium consist primarily of asci and paraphyses—organs borne in the center of the apothecium, forming there a unit structure which, for convenience in discussion, might well be called “the core.” This core is relatively large, hence easily handled, and it can be readily dissected from the rest of the plant when the specimens are moist. It is then possible to place the core on a slide and to spread out the asci and paraphyses in a smear preparation. This preparation is better adapted to the observation of certain structures and phenomena than either freehand or microtome sections, and numerous slides may be prepared by a simple method in a relatively short time.

The specimens are moistened with water and an apothecium is selected for study. The exciples are carefully removed with a needle or a small scapel and the gelatinous core of asci and paraphyses lifted from the thallus. Extreme care should be taken that no portion of the thallus or exciple adheres to the core, for if pieces of either are placed on the slide, broken cover glasses will almost invariably result when pressure is applied to the mount. Without further dissection the core is placed on a clean slide in a drop of acetocarmine. A cover glass is applied and the mount is pressed gently under a piece of absorbent paper. Another drop of acetocarmine is added to the edge of the cover glass and the preparation is heated to a temperature just below the boiling point of the stain. Many structures can be observed following this treatment, but before the greatest detail can become apparent the slides must be sealed and allowed to stand for one or two days.

By slight modifications iron-alum haematoxylin may be substituted for acetocarmine as a stain. Although the haematoxylin method takes somewhat longer it is slightly superior for staining chromatin in the ascus. Acetocarmine both fixes and stains, but the material must be fixed before haematoxylin is used (Navashin's solution proved satisfactory for our material). The cores are dissected out in the field

as described above and immersed in the fixative for 12-24 hours. They are then washed in water and placed in a 2% aqueous ferric ammonium sulphate solution for two hours. After a thorough washing they are stained overnight in a properly ripened  $\frac{1}{2}\%$  aqueous haematoxylin solution. The stain is then washed out with water and the cores destained (this process must be repeated until the differential point can be recognized from macroscopic examination) with ferric ammonium sulphate. When destaining is completed the material is again washed in water, after which the cores may be removed and each smeared on a slide as directed above. The water in the smear can be replaced with alcohol, the alcohol with xylol, and finally the xylol with balsam. The final embedding in balsam must be handled with extreme care since the desiccation by alcohol makes the core very hard and brittle and the smear can easily be damaged at this point.

The early lichenologists often did not study their material critically with a microscope, doing no more in this regard than to insert a needle into an apothecium and remove a few asci and paraphyses, incorporating such meagre observations into their specific concepts. Since that process gives all the essentials of a crude smear, the writers do not claim to be the first to apply this kind of preparation to the study of lichens. What they do wish, is to call attention to the fact that, with fresh material of some genera, structures rarely critically examined by lichenologists can be profitably studied by refined smear technique. (1) Far too little is known about the morphology of the ascus, which among lichens, often has a peculiar membrane. This membrane is usually distorted by dehydration and hence is not easily studied in sectioned material, but it appears distinctly in acetocarmine smear preparations. (2) The paraphyses stain beautifully and their characteristics can be more easily studied in smears than by any other method since their entire length is spread out on a single slide and often in one plane. (3) The nuclear condition of the ascus can be ascertained in all stages of development. This detail is not important in the delimitation of species but it is of value in any consideration of the relation of the lichens to the fungi. It is hoped that smears of lichens may provide a means of studying their cytology in the field, and even that lichen-cytology may become an effective aid to the taxonomy of the groups in question. Although these smears are as easily made as are smears with the anthers of higher plants, division figures were exceptionally rare in our random samples.

Smears seem a necessity in the study of the cytology of these lichens, however, and the writers believe that persistent sampling of the genera mentioned by such a method will eventually give the cytological picture of each genus.

#### SUMMARY

The apothecial contents of *Pertusaria*, *Ocellularia*, and *Thelotrema* can be dissected out with ease when the specimens are moist and smear techniques can be utilized for the quick preparation of members of these genera for microscopic observation. Slides prepared in this manner are useful for the examination of the ascus membrane, the paraphyses, and the nuclear condition of asci in various stages of development. Smears of the apothecial contents are as easy to make as pollen smears and their method of preparation gives promise of being very fruitful as a technique.

THE HENRY SHAW SCHOOL OF BOTANY, WASHINGTON UNIVERSITY,  
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#### MOSSES OF NEOTOMA, HOCKING COUNTY, OHIO<sup>1</sup>

RICHARD T. WAREHAM

Neotoma<sup>2</sup> is a small valley located in the central portion of the Sugar Grove region. This region, roughly delimited by Griggs (1913), is an elliptical area some twenty miles long from north to south, and ten miles wide from east to west, in Hocking and Fairfield Counties. It lies at the western edge of the Appalachian plateau and immediately south of the Illinoian and Wisconsin drift borders. The area is capped by resistant Black Hand conglomerate sandstone of Mississippian age. The characteristic weathering of this rock (Griggs, 1914a) has resulted in a deeply dissected region of precipitous cliffs, weathered caves, waterfalls, and deep gorges.

The region has for many years been known to botanists and zoologists alike for the richness and diverse affinities of its flora and fauna. Griggs (1913) discussed geographical affinities of many of the plants occurring there and (1914) listed 123 plants which there reach the limits of their ranges. William S. Sullivant, Leo Lesquereux, John

<sup>1</sup> Papers from the Department of Botany, Ohio State University, No. 429.

<sup>2</sup> The name Neotoma was originally applied to that portion of the valley owned by Mr. Edward S. Thomas, Curator of Natural History of the Ohio State Museum. We have used it to apply to the whole valley.

Bigelow, and H. C. Beardslee were among the early botanists who collected in this region. Among the places visited by thousands of nature-lovers each year are Ash Cave, Old Man's Cave, Cantwell Cliffs, and Rock House.

Most of the area has been cut over in lumbering and farming operations, although due to the extreme dissection, some few small and relatively inaccessible areas have never been cleared. Most of the flood plains and plateaus are now in cultivation or pasture. But many state park areas and privately owned tracts are now reverting to forest and are exhibiting many of the aspects of original vegetation. Such an area is Neotoma, a valley of about one hundred acres, approximately one mile long, lying northwest-southeast. It is a branch of Clear Creek valley and located one mile west of the junction of Clear Creek and the Hocking River. It is rimmed by cliffs which converge at the head of the valley forming a waterfall. The small valley floor is pastured in summer, but the talus slopes are wooded. No timber has been cut for over twenty years and some of the area has never been entirely cleared.

Since October, 1939, the writer, working with Drs. J. N. Wolfe and H. T. Scofield, has participated in an intensive botanical and ecological survey of this valley which is in progress, a project requiring weekly visits to the valley, and involving detailed observations and measurements of ecological factors. Collections of bryophytes as well as other plants have been undertaken. It is thought that the present list of one hundred and fourteen mosses collected within the limits of the valley would be of interest to bryologists and ecologists. No attempt has been made here to point out ecological and geographical affinities of the mosses listed. Specimens have been deposited in the Moss Herbarium at The Ohio State University.

#### LIST OF SPECIES

AMBLYSTEGIELLA SUBTILIS (Hedw.) Loeske	ATRICHUM UNDULATUM (Hedw.) Beauv.
AMPHIDIUM MOUGEOTII (Bry. Eur.) Schimp.	AULACOMNIUM HETEROSTICHUM (Hedw.) Bry. Eur.
ANDREAEA RUPESTRIS Hedw.	BARBULA UNGUICULATA Hedw.
ANOMODON ATTENUATUS (Hedw.) Hübner.	BARTRAMIA POMIFORMIS Hedw.
ANOMODON MINOR (Beauv.) Lindb.	BRACHYTHECIUM FLAGELLARE (Hedw.) Jennings
ANOMODON ROSTRATUS (Hedw.) Schimp.	BRACHYTHECIUM OXYCLADON (Brid.) Jaeger & Sauerb.
ATRICHUM ANGUSTATUM (Brid.) Bry. Eur.	BRACHYTHECIUM RIVULARE Bry. Eur.

- BRACHYTHECIUM RUTABULUM  
 (Hedw.) Bry. Eur.  
 BROTHERA LEANA (Sull.) C. Mull.  
 BROTHERELLA RECURVANS (Mx.)  
 Fleisch.  
 BROTHERELLA TENUIROSTRIS  
 (Schimp.) Broth.  
 BRUCHIA SULLIVANTI Aust.  
 BRYHNIA GRAMINICOLOR (Brid.)  
 Grout  
 BRYHNIA NOVAE-ANGLIAE (Sull. &  
 Lesq.) Grout  
 BRYOXIPHUM NORVEGICUM (Brid.)  
 Mitt.  
 BRYUM ARGENTEUM Hedw.  
 BRYUM CAESPITICUM Hedw.  
 BRYUM CAPILLARE Hedw.  
 BRYUM PSEUDOTRIQUETRUM (Hedw.)  
 Schwaegr.  
 CALLIERGONELLA SCHREBERI (Bry.  
 Eur.) Grout  
 CAMPYLUM CHRYSOPHYLLUM (Brid.)  
 Bryhn  
 CAMPYLUM CHRYSOPHYLLUM var.  
 BREVIFOLIUM (Ren. & Card.)  
 Grout  
 CAMPYLUM HISPIDULUM (Brid.)  
 Mitt.  
 CERATODON PURPUREUS (Hedw.)  
 Brid.  
 CHAMBERLAINIA ACUMINATA (Hedw.)  
 Grout  
 CIRRIPHYLLUM BOSCHII (Schwaegr.)  
 Grout  
 CLASMATODON PARVULUS var. RUPES-  
 TRIS Sull. & Lesq.  
 CLIMACIUM AMERICANUM Brid.  
 DICRANELLA HETEROMALLA (Hedw.)  
 Schimp.  
 DICRANODONTIUM DENUDATUM  
 (Brid.) E. G. Britton  
 DICRANUM CONDENSATUM Hedw.  
 DICRANUM FLAGELLARE Hedw.  
 DICRANUM FLVUM Hook.  
 DICRANUM MONTANUM Hedw.  
 DICRANUM SCOPARIUM Hedw.  
 DICRANUM SPURIUM Hedw.  
 DICRANUM VIRIDE (Sull. & Lesq.)  
 Lindb.  
 DIPHYCIUM FOLIOSUM (Hedw.)  
 Mohr  
 DITRICHUM PALLIDUM (Hedw.)  
 Hampe  
 DRUMMONDIA PROREPENS (Hedw.)  
 Jennings  
 ENTODON CLADORRHIZANS (Hedw.) C.  
 Müll.  
 ENTODON SEDUCTRIX (Hedw.) C.  
 Müll.  
 EURHYNCHIUM HIANIS (Hedw.)  
 Jaeger & Sauerb.  
 EURHYNCHIUM SERRULATUM (Hedw.)  
 Kindb.  
 FISSIDENS CRISTATUS Wils.  
 FISSIDENS GARBERI Lesq. & James  
 FISSIDENS MINUTULUS Sull.  
 FISSIDENS OSMUNDIOIDES Hedw.  
 FISSIDENS SUBBASILARIS Hedw.  
 FONTINALIS NOVAE-ANGLIAE Sull.  
 FUNARIA HYGROMETRICA Hedw.  
 GRIMMIA PILIFERA Beauv.  
 GYMNOSTOMUM CALCAREUM Nees &  
 Hornsch.  
 HAPLOHYMENIUM TRISTE (Cesati)  
 Kindb.  
 HEDWIGIA CILIATA Hedw.  
 HELODIUM PALUDOSUM (Sull.) Aust.  
 HETEROPHYLLIUM HALDANIANUM  
 (Grev.) Kindb.  
 HOOKERIA ACUTIFOLIA Hook.  
 HYGROAMBLYSTEGIUM FLUVIATILE  
 (Hedw.) Loeske  
 HYGROAMBLYSTEGIUM IRRIGUUM  
 (Wils.) Loeske  
 HYLOCOMIUM BREVIROSTRE (Beauv.)  
 Bry. Eur.  
 HYPNUM CURVIFOLIUM Hedw.  
 HYPNUM IMPONENS Hedw.  
 HYPNUM MOLLUSCUM Hedw.  
 HYPNUM PATIENTIAE Lindb.  
 HYPNUM REPTILE Mx.  
 LEPTODON TRICHOMITRIUM (Hedw.)  
 Mohr  
 LESKEA GRACILESCENS Hedw.  
 LEUCOBRYUM ALBIDUM (Brid.) Lindb.  
 LEUCOBRYUM GLAUCUM (Hedw.)  
 Schimp.  
 MNIUM AFFINE Bland.  
 MNIUM CUSPIDATUM Hedw.  
 MNIUM SERRATUM Brid.  
 MNIUM PUNCTATUM Hedw.  
 MNIUM STELLARE Hedw.  
 ORTHOTRICHUM OHIOENSE Sull. &  
 Lesq.  
 ORTHOTRICHUM STELLATUM Brid.  
 PHILONOTIS FONTANA (Hedw.) Brid.  
 PHYSCOMITRIUM TURBINATUM (Mx.)  
 Brid.  
 PLAGIOTHECIUM DENTICULATUM  
 (Hedw.) Bry. Eur.  
 PLAGIOTHECIUM ELEGANS (Hook.)  
 Sull.  
 PLATYGYRIUM REPENS (Brid.) Bry.  
 Eur.  
 PLEURIDIUM SUBULATUM (Hedw.)  
 Lindb.  
 POGONATUM BRACHYPHYLLUM (Rich.)  
 Beauv.

POGONATUM PENSILVANICUM (Hedw.) Paris	RHODOBRYUM ROSEUM (Bry. Eur.) Limpr.
POHLIA NUTANS (Hedw.) Lindb.	SCIAROMIUM LESCURI (Sull.) Broth.
POHLIA WAHLENBERGII (Web. & Mohr) Andrews	SEMATOPHYLLUM CAROLINIANUM var. ADMIXTUM (Sull.) Grout
POLYTRICHUM COMMUNE Hedw.	TETRAPHIS PELLUCIDA Hedw.
POLYTRICHUM JUNIPERINUM Hedw.	THELIA ASPRELLA Sull.
POLYTRICHUM OHIOENSE Ren. & Card.	THELIA HIRTELLA (Hedw.) Sull.
POLYTRICHUM PILIFERUM Hedw.	THUIDIUM DELICATULUM (Hedw.) Mitt.
POROTRICHUM ALLEGHENIENSE (C. Müll.) Grout	THUIDIUM VIRGINIANUM (Brid.) Lindb.
RHABDOWEISIA DENTICULATA (Brid.) Bry. Eur.	TORTELLA HUMILIS (Hedw.) Jennings
RHACOMITRIUM HETEROSTICHUM var. SUDETICUM (Funck) Jones	TORTELLA TORTUOSA (Turn.) Limpr.
	ULOTA AMERICANA (Beauv.) Limpr.
	ULOTA CRISPA (Hedw.) Brid.
	WEISIA VIRIDULA Hedw.

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 MOSSES OF SONORA

EDWIN B. BARTRAM AND DONALD RICHARDS

The mosses listed here were collected by Donald Richards and Francis Drouet in November and December, 1939, during the Field Museum Expedition to Sonora and southwestern United States. Assistance in collecting was received at various times from Mr. W. A. Lockhart and Mr. L. D. Alvarado, both of Los Angeles.

The moss flora of this part of Mexico is yet almost unknown. In his studies on Mexican mosses collected by C. G. Pringle and C. A. Purpus, Cardot (Rev. Bryol. 36: 110. 1909) reported only one species from Sonora, *Funaria (Entosthodon) sonorae*, described as new. No additional reports of mosses from Sonora have come to the attention of the authors.

Collecting was done during November in the arid rocky hills and palo verde scrub in the vicinity of Hermosillo, on the Río de Sonora. During this period a journey was made up the valley of the Río de Sonora to Ures and Baviácora, and from there over the mountains to Cumpas. Here were found excellent collecting grounds in the moist wooded ravines and open forests. From Cumpas the collecting was



carried on in the rugged and barren upland northward along the Río Nacozari as far as Nacozari and Pilares de Nacozari, and along the Río Moctezuma as far south as Moctezuma. This exploration yielded few mosses except in the occasional ravines kept moist by small streams. Another trip was made to Ímuris and Magdalena on the Río de los Álisos and Río Magdalena, in the northern part of the state. On the moist wooded slopes and cliffs along the rivers, bryophytes were abundant. The flood plain of the Río Mayo at Navajoa and the thorn forests of the mountains about Alamos were visited during December. The collecting was poor at both places but would probably be more productive during a rainy season. A careful search was made for bryophytes in the mountains along the coast near Guaymas but none were found. A similar situation was encountered in the littoral country in the neighborhoods of Yavaros and Bahía Kino.

In general the moss flora of Sonora shows a marked similarity to that of southern Arizona. This is to be expected since both regions are part of the large phytogeographic area known as the Sonoran Desert. The ecology and vegetation of this area have been described by Shreve (Bull. Torr. Bot. Club 61: 373-380. 1934, 64: 605-613. 1937). *Anoetangium euchloron*, *Tortula aurea*, *Didymodon mexicanus* var. *subulatus*, and *Barbula spiralis*, all typical of the arid mountain slopes of southern Arizona, were found in similar ecological niches in Sonora. The mosses of the desert and semi-arid habitats grow only during the short rainy seasons and remain completely desiccated for the remainder of the year; they appear to be few in number of species as well as in number of individuals. Observations made by the senior author on some of these species in the vicinity of Tucson over a period of years indicate that sporophytes are seldom if ever produced and that the plants propagate themselves wholly vegetatively. This has, unfortunately, made critical determination of some of the specimens difficult or even impossible.

Complete sets of specimens are deposited in the Cryptogamic Herbarium of Field Museum of Natural History, and the personal herbaria of E. B. Bartram, and Donald Richards.

To Dr. Francis Drouet, the authors wish to express appreciation for helpful suggestions and advice in the preparation of this paper.

## POTTIACEAE

*ANOECTANGIUM EUCHLORON* (Schwaegr.) Mitt., Journ. Linn. Soc. Bot. 12: 176. 1869.—On sandy soil along banks of Río Mayo, Navajoa, Dec. 9, 774 (mixed with *Splachnobryum Bernoullii*); on slope of Cerro de la Campaña, Hermosillo, Nov. 1, 578; on banks of Río de Sonora west of Hermosillo, Nov. 7, 613; on slope of mountain at outskirts of Villa de Seris, Nov. 3, 591; idem, on hill 5 km. south-west, Nov. 6, 610. An uncommon species in southern Arizona apparently becoming more frequent in northern Mexico.

*ANOECTANGIUM ARIZONICUM* Bartr. in Grout, Moss Flora N. Amer. 1: 192. 1938.—On dry soil in ravine 3 miles south of Nacozari, Nov. 20, 706, 710; idem, on moist shaded soil, 709; in ravine 1 mile north of Jecorí, Nov. 20, 719. Previously known only from the original station in southern Arizona.

*MERCEYA LIGULATA* (Spruce) Schimp., Syn. (ed. 2), 852. 1876.—On moist rock ledge in canyon 26 miles southwest of Cumpas, Nov. 21, 729.

*WEISIA TORTILIS* (Schwaegr.) C. M., Syn. Musc. 1: 661. 1849.—On dry soil in canyon west of Baviácora, Nov. 16, 650 (mixed with *Barbula spiralis*); in crevices of rock on Cerro de la Campaña, Hermosillo, Nov. 1, 571.

*WEISIA VIRIDULA* Hedw., Fund. 2: 90. 1781: Sp. Musc. 68. 1801 (as synonym).—In shade of boulders, 3 miles west of Pílares de Nacozari, Nov. 19, 701; on soil on wall of canyon west of Baviácora, Nov. 21, 668; in small ravine 20 miles northeast of Ures, Nov. 16, 637; idem, in shade of trees, 636.

*WEISIA JAMAICENSIS* (Mitt.) Grout, Moss Flora N. Amer. 1: 157. 1938.—On barren hillside at Estación Río de Sonora, near Hermosillo, Nov. 25, 740.

*HUSNOTIELLA TORQUESCENS* (Card.) Bartr., THE BRYOLOGIST 29: 45. 1926.—On exposed soil in ravine 1 mile north of Jecorí, Nov. 20, 718; in ravine 20 miles northeast of Ures, Nov. 16, 639; dry soil on slope of mountains south of Hermosillo, Nov. 2, 586; idem, at foot of Sierra de Calera, 589.

*TRICHOSTOMUM BRACHYDONTIUM* Bruch, Flora 2: 393. 1829.—On side of mountain just west of Alamos, Dec. 12, 782, 785; idem, on road embankment 2 miles north, Dec. 13, 786; on rock ledges in mountains 20 miles northeast of Ures, Nov. 16, 635; idem, on soil near top of ravine, 643.

*DIDYMODON MEXICANUS* var. *SUBULATUS* Thér. & Bartr., THE BRYOLOGIST 29: 1. 1926.—On rocky hillside 17 miles southwest of Baviácora, Nov. 22, 735. Often frequent on the bajada slopes in southern Arizona but not previously reported from Mexico.

*BARBULA BESCHERELLEI* Sauerb. in Jaeg., Adumb. 2: 673. 1878.—On mountainside west of Baviácora, Nov. 16, 654; idem, Nov. 17, 662; on wet limestone bluff south of Jecorí, Nov. 20, 714.

BARBULA CRUEGERI Sond. in C. M., Syn. Musc. 1: 622. 1849.—Along banks of Río de Sonora near Ures, Nov. 15, 629. Specimen with abundant propagula. An interesting range extension of a typically southern Coastal Plains species. This appears to be the first collection reported from the Pacific watershed.

BARBULA SPIRALIS Schimp. in C. M., Syn. Musc. 1: 622. 1849.—In ravine 3 miles south of Nacozari, Nov. 20, 711; on wet limestone cliff just south of Jecorí, Nov. 20, 713; along banks of Río de Sonora near Baviácora, Nov. 16, 646; on mountain side west of Baviácora, Nov. 16, 653; idem, on shaded soil, 655; idem, on wall of canyon, 658; idem, 649; idem, on soil in canyon, 647; on rocky hillside 17 miles southwest of Baviácora, Nov. 22, 734; at base of mesquite tree in small ravine 20 miles northeast of Ures, Nov. 16, 640; on rocks along road to Union, east of Hermosillo, Nov. 4, 605; under projecting rocks on slope of Cerro de la Campana, Hermosillo, Nov. 1, 576, 577; on rocky slope of mountain 4 km. south of Villa de Seris, Nov. 26, 743, 746. This is one of the most common and widespread mosses in Mexico.

TORTULA BARTRAMII Steere in Grout, Moss Flora N. Amer. 1: 241. 1939.—In wet places in ravine 3 miles south of Nacozari, Nov. 20, 705 (mixed with *Fabronia Wrightii* var. *intermedia*), 707; on dry exposed rock surfaces in canyon 18 miles southwest of Cumpas, Nov. 21, 723. This species has been collected in southern Arizona, New Mexico, and California. This is the first collection to be reported from Mexico.

TORTULA AUREA Bartr., Bull. Torr. Bot. Club 51: 339. 1924.—On wall of canyon 15 miles south of Nacozari, Nov. 19, 696; idem, on wall of ravine 3 miles south, Nov. 20, 712; on shaded soil in mountains just west of Baviácora, Nov. 16, 655a; in mountains 21 miles northeast of Ures, Nov. 22, 738; on shaded soil on rocky hillside along Río Magdalena, west of Magdalena, Nov. 29, 769; on boulders on side of Cerro de la Campana, Hermosillo, Nov. 1, 573; idem, on rock ledge, 574; on dry soil on slope of mountains south of Hermosillo, Nov. 2, 588; on mountains near Union, east of Hermosillo, Nov. 4, 600; idem, on soil near road, 601; idem, under projecting rocks, 603; idem, on bare hills at Estación Río Sonora, Nov. 25, 739. Distributed through western Texas, southern New Mexico, southern Arizona, and Mexico (*vide* W. C. Steere).

#### GRIMMIACEAE

GRIMMIA ARIZONAE Ren. & Card., Rev. Bryol. 19: 85. 1892.—On rock ledges in deep ravine 11 miles northeast of Baviácora, Nov. 18, 675. This distinct species has been collected in southern Arizona, New Mexico, and the mountains of western Texas. It is therefore not surprising to find it in the collection from Sonora.

COSCINODON WRIGHTII Sull., Mosses U. S. 38. 1856.—On dry soil at foot of Cerro de la Campana, Hermosillo, Nov. 1, 568.

## FUNARIACEAE

FUNARIA SONORAE Card., Rev. Bryol. 36: 110. 1909.—In mountains 21 miles northeast of Ures, Nov. 22, 736; on banks of Río de los Alisos near Ímuris, Nov. 28, 762; on dry sandy road embankment, Villa de Seris, Nov. 3, 594, 595, 598; under projecting rocks on hills southwest of Villa de Seris, Nov. 6, 608 (mixed with *Bryum argenteum*); idem, on hills 4 km. south, Nov. 26, 742. This is a characteristic species of dry, exposed situations in Sonora.

FUNARIA MUHLENBERGII Turn. in König Sims Ann. Bot. 2: 198. 1805.—Under palo verde trees in mountains west of Baviácora, Nov. 16, 652; on rocky hillside near Río Magdalena, Magdalena, Nov. 29, 768; in crevices of rock on mountain near Villa de Seris, Nov. 3, 592.

## SPLACHNACEAE

SPLACHNOBRYUM BERNOULLII C. M., Verh. k. k. zool. bot. Ges. Wien 505. 1869.—On wet ground in ravine 11 miles northeast of Baviácora, Nov. 18, 672; on banks of Río de Sonora west of Hermosillo, Nov. 7, 616.

## BRYACEAE

BRYUM ARGENTEUM Hedw., Sp. Musc. 181. 1801.—Along roadside on dry sandy soil, Villa de Seris, Nov. 3, 596; idem, on rocky slope 4 km. south, Nov. 26, 741.

Several additional collections of *B. argenteum* were found mixed with other species and are cited with those species.

BRYUM ARGENTEUM var. LANATUM (Beauv.) Bruch & Schimp., Bry. Eur. 6: 7. 1839.—In shaded places in canyon west of Baviácora, Nov. 16, 651; in small ravine 20 miles northeast of Ures, Nov. 16, 642; at base of cactus on dry rocky hillside near Río Magdalena, west of Magdalena, Nov. 29, 764.

A number of collections of sterile *Bryum* spp. were made, but determinations of such specimens are too uncertain to be of any value and are therefore not listed here.

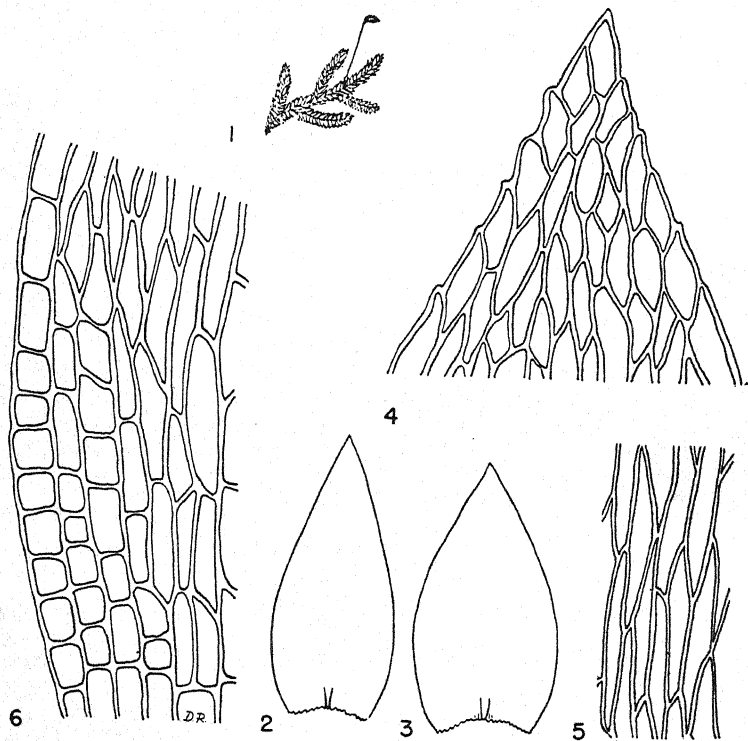
## BARTRAMIACEAE

PHILONOTIS GRACILLIMA Aongstr., Öfv. Kgl. Vet.-Akad. Förh. 33: 17. 1876.—In ravine 11 miles northeast of Baviácora, Nov. 18, 691.

## ERPODIACEAE

ERPODIUM OPUNTIAE Card., Rev. Bryol. 37: 6. 1910.—On bark of tree on mountainside west of Baviácora, Nov. 17, 666; on decayed bark, mountains 21 miles northeast of Ures, Nov. 22, 737; on rocks under mesquite tree, 4 km. south of Villa de Seris, Nov. 26, 744.

Previously known only from the original station in Oaxaca (Pringle, 31a) as far as we can determine. This is an interesting northward extension of a unique species.



Figs. 1-6. *ISOPTERYGIUM RICHARDSII* Bartr. 1. Plant,  $\times 45$ . 2, 3. Leaves,  $\times 45$ . 4. Apex of leaf,  $\times 400$ . 5. Median leaf cells,  $\times 400$ . 6. Alar cells,  $\times 400$ .

#### FABRONIACEAE

*FABRONIA WRIGHTII* Sull., Mosses U. S. 61. 1865.—In oak woods on slope of mountain between Baviácora and Cumpas, Nov. 18, 687.

*FABRONIA WRIGHTII* var. *INTERMEDIA* Grout, Bryol. 29: 4. 1926.—In canyon 18 miles southwest of Cumpas, Nov. 21, 727; on rocks in ravine 11 miles northeast of Baviácora, Nov. 18, 669, 670; on tree on slope of Cerro Agua Caliente, along Río de los Alisos, Ímuris, Nov. 28, 755. This is the first record of this species for Mexico.

#### HYPNACEAE

*Isopterygium richardsii* Bartram, sp. nov. Autoicum; gracile, viride, haud nitidum. Caules irregulariter ramosi prostrati, ramis

humida valde complanatis, circa 1 cm. longis. Folia concava, patentia, vix 0.75 mm. longa, 0.35 mm. lata, ovato-lanceolata, breviter acuminata, marginibus planis e basi fere denticulatis; costa bina, brevis, male notata; cellulae lineares, 6  $\mu$  latae, 10-13 : 1, ad apicem folii breviores, alares numerosae, subquadratae. Seta 7 mm. longa, rubra; theca inclinata, oblongo-elliptica, deoperculata, 1 mm. longa; operculum conicum, alte apiculatum.

Autoicous; slender, dull green. Stems irregularly branched, prostrate, branches about 1 cm. long, complanate when moist. Leaves ovate-lanceolate, concave, short acuminate, scarcely 0.75 mm. long by 0.35 mm. wide; margins plane, denticulate nearly to the base; costa weak, double and short; leaf cells linear, about 6  $\mu$  wide, 10-13 : 1, much shorter in the apical portion, subquadrate alar cells numerous in a well defined area. Seta to 7 mm. long, red; capsule inclined, oblong-elliptical, urn, 1 mm. long; operculum conic with a sharp high apiculus.

On soil on boulders along Río de los Alisos, Ímuris, Nov. 28, 757 (Type in Cryptogamic Herbarium of Field Museum; isotypes in herbaria of E. B. Bartram, Donald Richards, University of Michigan, and Farlow Herbarium); idem, on side of Cerro Agua Caliente, Nov. 28, 749; in canyon 18 miles southwest of Cumpas, Nov. 21, 722; in deep ravine 11 miles northeast of Baviácora, Nov. 18, 676.

This species is well distinguished by the small, broadly pointed leaves toothed nearly to the base with numerous subquadrate alar cells in a well marked group. *I. micans* of the eastern United States has more slenderly pointed leaves with fewer alar cells and longer setae, and is lighter in color. There appears to be no southwestern species with which it may be compared.

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## SOUTHERN APPALACHIAN BRYOPHYTES IN EUROPE\*

A. J. SHARP

The Southern Appalachian Mountains of eastern United States bear a bryophytic flora which is abundant both in numbers of species and in numbers of individuals. Many of the species show definite geographical affinities. These have been classified and listed by the author<sup>1</sup> according to the American areas in which they show their greatest frequency of occurrence.

\* Contributions from the Botanical Laboratory, The University of Tennessee, N. Ser. 46.

<sup>1</sup> Sharp, A. J. Taxonomic and ecologic studies of eastern Tennessee bryophytes. Amer. Midl. Nat. 21: 267-354. 1939.



The present paper is concerned with the possible occurrence and distribution of these same species in Europe. For pertinent geographical data the author has relied chiefly on the publications of Müller<sup>1</sup> and Mönkemeyer.<sup>2</sup>

It is interesting that all of the twenty-nine species of Southern Appalachian bryophytes which have their greatest frequency of occurrence in the American Northern Coniferous Forest Region are found also in Europe. Moreover, nineteen of these have their greatest frequency of occurrence in the northern half of Europe (*Blindia acuta*, *Campylium polygamum*, *Dichodontium pellucidum*, *Hygrohypnum eugyrium*, *H. ochraceum*, *Hylocomium umbratum*, *Hypnum fertile*, *H. reptile*, *Myurella Careyana*, *M. julacea*, *Nardia scalaris*, *Oreoweisia serrulata*, *Paraleucobryum longifolium*, *Plagiothecium elegans*, *P. striatellum*, *Pohlia elongata*, *Rhabdoweisia denticulata*, *Seligeria Doniana* and *Sphagnum Girgensohnii*). If their ranges extend southward, they are restricted in the southern portion to the higher elevations. Of the ten which are more generally distributed over Europe, several are more common there in the mountains (*Brachythecium rutabulum*, *Dicranum rugosum*, *Drepanocladus exannulatus*, *D. Sendtneri*, *Hygrohypnum dilatatum*, *H. luridum*, *Hylocomium splendens*, *Hypnum Crista-castrensis*, *Rhytidiadelphus squarrosus* and *Sphagnum squarrosus*).

Of the twelve Southern Appalachian species which have disjunct ranges but are evidently allied to the Northern Coniferous group, nine are found in Europe (*Amblystegiella confervoides*, *Anomodon tristis*, *Bazzania tricenata*, *Dicranodontium asperulum*, *Grimmia teretinervis*, *Hygrohypnum alpestre*, *H. cochlearifolium*, *Plagiothecium lactum*, *Zygodon viridissimus*). Only the last named is common at low elevations or latitudes.

Of the twenty-three Southern Appalachian bryophytes exhibiting affinities with the flora of Nichols' Eastern Hemlock Region,<sup>3</sup> only sixteen have been reported from Europe (*Anomodon Rugelii*, *Bryhnia novae-angliae*, *Cirriphyllum piliferum*, *Dichelyma capillaceum*, *Heterophyllum Haldanianum*, *Homalia Jamesii*, *Hygrohypnum novae-*

<sup>1</sup> Müller, K. Die Lebermoose. (Vol. 6, Rabenhorst's Kryptogamenflora.) Leipzig. 1905-16.

<sup>2</sup> Mönkemeyer, Wilh. Die Laubmoose Europas. (Vol. 4, Rabenhorst's Kryptogamenflora.) Leipzig. 1927.

<sup>3</sup> Nichols, G. E. The Hemlock-White Pine-Northern Hardwood Region of Eastern North America. Ecology 16: 403-422. 1935.

*caesareae*, *Lophozia excisa*, *Microlejeunea ulicina*, *Mylia cuneifolia*, *Neckera complanata*, *Plagiochila tridenticulata*, *Plagiothecium Muellerianum*, *Pleuroidium palustre*, *Pseudisothecium myosuroides* and *Ulotia Ludwigii*). *Bryhnia novae-angliae* and *Homalia Jamesii* have been collected there very rarely. *Neckera complanata* is rather common throughout Europe and *Ulotia Ludwigii* is rare northwards. The other twelve appear to be more common at higher rather than at lower elevations and latitudes.

Of the fifteen Southern Appalachian species exhibiting affinities with the flora of the Coastal Plain and the Mississippi Embayment only five are reported from Europe and it is difficult to generalize about their distribution on that continent (*Atrichum crispum*, *Campylostelium saxicola*, *Mnium hornum*, *Sphaerocarpus texanus* and *Sphagnum Pylaeisii*).

The tropical and subtropical bryophytes which are found in the Southern Appalachians may be divided into two groups: (1) those which range into the Coastal Plain of the southern United States, and (2) those which exhibit disjunction and do not occur there. In both cases approximately one-third of the species are found in Europe: six (*Campylopus flexuosus*, *Hyophila Tortula*, *Leucobryum albidum*, *Pallavicinia Lyellii*, *Thuidium minutulum* and *T. virginianum*) out of twenty in the Coastal Plain group and five (*Campylopus introflexus*, *Hymenostomum tortile*, *Heterophyllum nemorosum*, *Merceya ligulata* and *Metzgeria hamata*) of fifteen in the disjunct group. Two tropical genera (*Acrobolbus* and *Bartramidula*) found in the Southern Appalachians are represented in the British Isles by species different from those in the United States.

Of the bryophytes truly endemic to the Southern Appalachians, none is found in Europe, of course. One European species, *Riccardia incurvata*, is restricted to the Southern Appalachians in so far as its range in North America is known.

There seems to be a correlation between the American affinities of the geographically-significant Southern Appalachian bryophytes and their occurrence in Europe: those with northern affinities having the largest representation in Europe; those with tropical, the least.

The percentage of Southern Appalachian species which exhibit affinities with the Coastal Plain flora and which occur also in Europe, is small (33 $\frac{1}{3}$ %). This fact may prove of importance in the solution of the problem of origin and distribution of the so-called "Coastal

Plain species" in the Southern Appalachians. Two explanations have been offered: (1) they originated in and migrated from the mountains, and (2) they originated in the Coastal Plain and migrated to the mountains. The distribution of bryophytes might be interpreted as supporting the second theory because if they had originated in the mountains, a larger percentage might be expected to be indigenous to Europe.

A classified list of geographically-significant Southern Appalachian bryophytes which do not occur in Europe is appended:

I. Those with their greatest frequency of occurrence in the Northern Coniferous Forest: none.

II. Those disjunct but allied to those in I: *Bazzania denudata*, *Brothera Leana*, *Bryoxiphium norvegicum*.

III. Those which occur with greatest frequency in the Eastern Hemlock Region: *Anoetangium Peckii*, *Grimmia Olneyi*, *Herberta tenuis*, *Radula tenax*, *Thuidium pygmaeum*, *Tortula Porteri*.

IV. Those common to the Coastal Plain: *Crossotolejeunea bermudiana*, *Cryphaea glomerata*, *C. nervosa*, *Fabronia Ravenelii*, *Homalothecium fabrofolia*, *Fontinalis Sullivantii*, *Plagiothecium micans*, *Radula caloosiensis*, *Tetraplodon pennsylvanicus*, *Tortula plinthobia*.

V. Tropical and subtropical mosses: *Anoetangium euchlorum*,<sup>1</sup> *Barbula Cruegeri*, *Campylopus tallulensis*, *Drepanolejeunea bidens*,<sup>1</sup> *Entodon Drummondii*, *Fissidens polypodioides*, *Herpetineurum toccoeae*, *Homalothecium Bonplandii*,<sup>1</sup> *Hookeria acutifolia*,<sup>1</sup> *Leptodontium excelsum*,<sup>1</sup> *L. Orcuttii*,<sup>1</sup> *Leucolejeunea unciloba*, *Marchantia domingensis*, *Metzgeria myriopoda*, *Orthodontium pellucens*,<sup>1</sup> *Philonotis longiseta*, *Plagiochila undata*, *Radula andicola*, *Rectolejeunea Maxonii*, *Sematophyllum adnatum*, *Tortula caroliniana*,<sup>1</sup> *T. fragilis*,<sup>1</sup> *Zygodon Reinwardtii*.<sup>1</sup>

VI. Endemic species: *Acrobolbus rhizophyllum*, *Bartramidula caroliniae*, *Bazzania nudicaulis*, *Diplophyllum Andrewsii*, *Entodon Sullivantii*, *Euosmolejeunea Evansii*, *Fabronia imperfecta*, *Homalia Sharpii*, *Macromitrium Sullivantii*, *Oncophorus Raui*, *Porella wataugensis*, *Radula Sullivantii*, *Schlotheimia lancifolia*, *Tortula propagulosa*.

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<sup>1</sup> Not known from the Coastal Plain of Southern United States.

PHYSIOLOGICAL STUDIES ON MOSSES. II. SPORE  
LONGEVITY IN *PHYSCOMITRIUM TURBINATUM*  
AND *FUNARIA HYGROMETRICA*<sup>1</sup>

SAMUEL L. MEYER

One of the most interesting aspects of the general subject of the physiology of mosses is that which deals with the viability of old spores. The literature contains varied reports concerning the longevity of moss spores and presents a background for the investigation reported here.

In a general discussion of the conditions for germination of moss and hepatic spores, Chalaud (1932) called attention to the fact that the spores of bryophytes retain their power to germinate for long periods of time. That writer observed that the spores of *Sphagnum* germinated three years after collection while the spores of *Oedipodium* germinated after twenty years. Chalaud (1932) also cited the work of Schimper (1848) who stated that the spores of certain mosses germinated after fifty years in the herbarium. Schimper's (1848) report was questioned by Correns (1899). Treboux (1905) observed that in some species the storage of spores for one year reduced the power to germinate. Kessler (1914) noted that the spores of *Funaria hygrometrica* used by Müller-Thurgau (1874) germinated four years after they were collected, and Müller-Thurgau (1874) himself stated that they germinated as effectively as those which came from fresh capsules. This observation was also cited by Janzen (1909) whose efforts to obtain the germination of spores of the same species, eight and twenty-five years after collection, were unsuccessful. Lesage (1918) showed that the spores of several moss species were capable of germination after three to seven years. Spores of *Funaria hygrometrica* collected in 1910, those of *Funaria microstoma* collected in 1912 and those of *Pottia Starkeana* collected in 1914 germinated in 1917. Malta (1921) reported that spores of *Grimmia pulvinata* germinated after seventy years in a herbarium though he later (Malta, 1922) mentioned that this observation could not be confirmed through repeated reinvestigations and suggested that contamination of the cultures with young viable spores had occurred. Malta (1922) studied the longevity of moss spores for some 200 species of eighty genera. The oldest spores which germinated were those of *Ceratodon purpureus* and *Funaria*

<sup>1</sup> Contributions from the Botanical Laboratory, The University of Tennessee, N. Ser. 47.

*hygrometrica*. In the former species, spores germinated after sixteen years; in the latter, after thirteen years. In his investigations, Malta (1922) used spores of *Funaria hygrometrica* which were four, five, nine, eleven, twelve, thirteen, and sixteen years old, a total of seven collections. His tables indicate that spores of *Physcomitrium pyriforme*, the European counterpart of *Physcomitrium turbinatum*, that were five and eighteen years old did not germinate. Spores from only two collections of that species were examined. In concluding the discussion of his results, Malta (1922) made this very interesting statement: "Es ist trotz meiner Befunde selbstverständlich nicht ausgeschlossen, dass Keimungen von Laubmoossporen auch nach mehreren Jahrzehnten möglich sind. Den angeführten Resultaten zufolge durften solche Fälle jedoch nur seltene Ausnahmen darstellen." Wettstein (1925) stated that the report of Schimper (1848) in which spores were said to have remained viable for fifty years required re-examination and called attention to the fact that more accurate observations are needed concerning the whole question of viability in moss and hepatic spores since "meist die Herkunft des Materiales als altes Herbarmaterial mit grossen Fehlerquellen beim Trocknungsprozess eine Ungleichheit des Ausgangsmateriales wahrscheinlich macht."

In this study, spores of *Physcomitrium turbinatum* (Michx.) Brid. and *Funaria hygrometrica* Hedw. were used. Both species are members of the Family Funariaceae and are evidently closely related. Capsules were obtained from the New York Botanical Garden, the Academy of Natural Sciences of Philadelphia, the Vanderbilt University Herbarium, the Johns Hopkins University Herbarium, and the herbaria of Hollins College, the University of Virginia, and the University of Tennessee. Spores were sown on a solid substrate of nutrient agar and in a liquid nutrient medium. The nutrient solution in each case was that of Benecke, as used by Wettstein (1924) in his genetic studies of mosses. There was a marked correlation in spore germination on the two types of culture media. Cultures were placed in a northern daylight exposure which was supplemented by artificial light from Mazda daylight bulbs. Final observations were made after a period of thirty days.

It is recognized, of course, that Wettstein's (1925) criticism of the use of old herbarium material, as previously cited, is justified. No information is available as to what has happened to the spores since the time of collection. The capsules may have been variously treated

and subjected to very different conditions. These are factors over which those who use old herbarium material in the study of spore longevity have no control. It may be assumed, however, that if the usual methods of collection and storage of mosses have been followed, one fact is common to all collections—the spores have been subjected to the most xeric conditions. It is believed that the use of spores from a large number of collections in several herbaria provide a basis for interesting observations on the retention of viability by moss spores under such conditions. On that basis, this investigation has been carried forward. Preliminary reports containing a part of these data have been presented (Meyer, 1940a; 1940b).

TABLE I. Spore longevity in *Physcomitrium turbinatum*. Spores were sown on an inorganic nutrient medium. Observations were made after a period of 30 days. A plus sign (+) indicates spore germination; a minus sign (—) indicates no germination at the conclusion of the investigation.

Culture Number	Date	Locality	Source	Germination
1	1868	Pennsylvania	Philadelphia Academy	—
2	1879	Connecticut	New York Botanical Garden	—
3	1890	New York	New York Botanical Garden	—
4	1897	Alabama	Johns Hopkins University	—
5	1899	Illinois	Johns Hopkins University	—
6	1903	Illinois	Johns Hopkins University	—
7	1904	Florida	Johns Hopkins University	—
8	1908	West Virginia	New York Botanical Garden	—
9	1910	Vermont	Vanderbilt University	—
10	1917	Florida	New York Botanical Garden	—
11	1924	Louisiana	New York Botanical Garden	—
12	1928	New York	University of Tennessee	—
13	1929	Florida	University of Tennessee	—
14	1931	Georgia	New York Botanical Garden	—
15	1931	Iowa	University of Tennessee	—
16	1933	North Carolina	University of Tennessee	—
17	1934	Tennessee	University of Tennessee	—
18	1935	Tennessee	University of Tennessee	—
19	1936	Tennessee	University of Tennessee	—
20	1937	South Carolina	Hollins College	—
21	1938	Virginia	University of Virginia	—
22	1939	Virginia	University of Virginia	+
23	1939	Oregon	University of Tennessee	+
24	1940	Virginia	University of Virginia	+
25	1940	Missouri	University of Tennessee	+

Table I shows the results obtained with spores of *Physcomitrium turbinatum*. Spores from twenty-five collections in twenty-two years, dating to 1868, were used. The only spores which germinated in 1940 were those from the 1939 and 1940 collections. No spores germinated from collections older than two years.



TABLE II. Spore longevity in *Funaria hygrometrica*. Spores were sown on an inorganic nutrient medium. Observations were made after a period of 30 days. A plus sign (+) indicates spore germination; a minus sign (—) indicates no germination at the conclusion of the period of investigation.

Culture Number	Date	Locality	Source	Germination
1	1828	Unknown	New York Botanical Garden	—
2	1842	Ohio	New York Botanical Garden	—
3	1850	Germany	New York Botanical Garden	—
4	1857	South Carolina	University of Tennessee	—
5	1858	New York	New York Botanical Garden	—
6	1866	New Jersey	New York Botanical Garden	—
7	1872	Connecticut	New York Botanical Garden	—
8	1882	New Jersey	University of Tennessee	—
9	1887	Montana	New York Botanical Garden	—
10	1890	Delaware	Philadelphia Academy	—
11	1892	Michigan	University of Tennessee	—
12	1894	New York	New York Botanical Garden	—
13	1898	Washington	University of Tennessee	—
14	1906	West Virginia	New York Botanical Garden	—
15	1906	Pennsylvania	Philadelphia Academy	—
16	1910	Russia	University of Tennessee	—
17	1914	Colorado	University of Tennessee	—
18	1915	Florida	New York Botanical Garden	—
19	1916	Florida	University of Tennessee	—
20	1916	Maine	University of Tennessee	—
21	1922	Vermont	Vanderbilt University	—
22	1924	Arizona	New York Botanical Garden	—
23	1926	Pennsylvania	University of Tennessee	—
24	1927	New Jersey	Philadelphia Academy	—
25	1928	Montana	University of Tennessee	—
26	1928	West Virginia	University of Tennessee	—
27	1929	North Carolina	Vanderbilt University	—
28	1930	British Columbia	University of Tennessee	—
29	1931	New York	University of Tennessee	—
30	1931	Tennessee	University of Tennessee	—
31	1932	Michigan	University of Tennessee	+
32	1932	Tennessee	Vanderbilt University	+
33	1933	Tennessee	Vanderbilt University	+
34	1934	Virginia	Hollins College	+
35	1935	Tennessee	University of Tennessee	+
36	1936	Florida	New York Botanical Garden	+
37	1937	Virginia	University of Virginia	+
38	1938	Tennessee	University of Tennessee	+
39	1939	Virginia	University of Virginia	+
40	1939	Tennessee	University of Tennessee	+
41	1940	Tennessee	University of Tennessee	+

Table II shows the results obtained with spores of *Funaria hygrometrica*. Spores from forty-one collections in thirty-five years, dating to 1828, were used. Spores germinated in 1940 from collections of 1932 to 1940, inclusive. No spores of this species that were more than eight years old germinated.

An interesting comparison concerning the longevity of spores of the two species under herbarium conditions is shown in Table III. In *Funaria hygrometrica*, spores from collections dating from 1940 through 1932 germinated; in *Physcomitrium turbinatum*, spores from collections of 1939 and 1940 only germinated. Spores of the latter species from collections dating from 1938 to 1933 failed to germinate while those of the former species collected in the same years gave positive results. These results indicate that spores of closely related genera may differ markedly in their retention of viability under herbarium conditions.

TABLE III. A comparison of spore longevity in *Physcomitrium turbinatum* and *Funaria hygrometrica*. A plus sign (+) indicates spore germination; a minus sign (-) indicates no germination at the conclusion of the investigation.

Date of Collection	Germination in <i>Physcomitrium turbinatum</i>	Germination in <i>Funaria hygrometrica</i>
1931	-	-
1932	-	+
1933	-	+
1934	-	+
1935	-	+
1936	-	+
1937	-	+
1938	-	+
1939	+	+
1940	+	+

As a result of his studies on retention of germinative power by spores of various moss species when subjected to extremely low temperatures, Becquerel (1932a, 1932b) suggested that the failure to kill by freezing is due to the extreme dryness of the spores since, by such dehydration, they are reduced "à l'état de vie suspendu." In summarizing his extensive researches of thirty years on the retention of viability by seeds, spores, bacteria, fungi, mosses, ferns, protozoa and pollen grains, Becquerel (1936) concluded that the protoplasm of plants and animals, when plasmolysis does not occur during dehydration, can lose its colloidal state, passing from the semifluid to the solid condition, and, thereby, retain indefinitely the power to revive. As Becquerel (1936) stated it: "Il est donc possible de suspendre expérimentalement tous les phénomènes physicochimiques de la vie sans provoquer la mort." The idea that physiological processes in living organisms may actually be suspended without causing death was supported by the studies of Lipman (1936) on moss protonemata when it was pointed out that "living organisms do not need to respire to retain

the power to develop into vegetative forms when proper experimental conditions are supplied."

It is highly probable that the retention of viability by moss spores over a period of several years may be attributed to reduced physiological activity accompanying gradual dehydration. Under herbarium conditions, it is probable that the moisture content of spores is reduced to the minimum compatible with life. This reduction is so great that the living protoplasm of the spores may be considered to be in a state of suspended physiological activity, the "vie suspendu" of Becquerel (1932b) and the "suspended animation" of Lipman (1936). The fact that spores of *Funaria hygrometrica*, having protoplasts ranging in size from thirteen to sixteen micra in diameter, retain the power to germinate and produce protonemata after periods of eight years under the most xeric conditions is further evidence of the remarkable ability of living things to resist death through desiccation.

These observations may be summarized as follows:

1. Spores of *Physcomitrium turbinatum* collected in 1939 and 1940 germinated in 1940 while spores of the same species from twenty-one other collections, dating to 1868, failed to germinate.
2. Spores of *Funaria hygrometrica* from collections of 1932 to 1940, inclusive, germinated in 1940 while spores of that species from thirty other collections, dating to 1828, failed to germinate.
3. Results indicate that moss spores of closely related genera may differ in the retention of the germinative power under herbarium conditions.
4. It is suggested that the retention of viability by moss spores may be attributed to reduced physiological activity accompanying dehydration.

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Extra copies of the Special Check List Number of *THE BRYOLOGIST* (October, 1940), containing lists of the North American species of mosses, Sphagna, and Hepaticae, may be obtained at the much reduced price of ten cents each, in any quantity, from the Curator of the S. M. S. Moss Herbarium: Dr. LEWIS E. ANDERSON, Department of Botany, Duke University, Durham, N. C. Reprints of the check list of Hepaticae may be purchased in any quantity, for two cents each (plus postage), from the curator of the S. M. S. Hepatic Herbarium: Dr. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

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Beginning January 1, 1939, this Club has been operated under the same rules as The Moss Exchange Club. Privileges are available only to members of the Sullivant Moss Society who have paid annual dues of 25c to Dr. A. J. SHARP, Department of Botany, University of Tennessee, Knoxville, Tennessee. Only fully determined specimens in packets with complete data will be accepted. It is suggested that there be at least five packets of each species with an extra which will be forwarded to the Curator of Hepatics for the Sullivant Moss Society Hepatic Herbarium. All material for determination should be sent to the Curator of Hepatics, Dr. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

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# THE BRYOLOGIST

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## THE GEMMALING OF *RIELLA AMERICANA*. I.

R. A. STUDHALTER AND MARTHA ENNA COX

### I. INTRODUCTION

*Summary of literature.*—The gemma, first recognized in the genus *Ricella* by Howe and Underwood (4) in 1903, had nevertheless first been pictured for this submerged aquatic liverwort by Leitgeb (5) in 1879, as has been noted in a previous paper (9). The gemmaling also of this distinctive genus was not definitely recognized until after the beginning of the present century, although Goebel (2) in 1893 first called attention to the fact that the first figure of a paper published in 1887 by Trabut (12) represents a gemmaling of *Ricella Cossoniana*. This belief was concurred in by Howe and Underwood (4) in 1903 and by Porsild (6) in the same year. These authors further believed correctly that Trabut's second figure, representing a somewhat older plant, also had its origin from a gemma. In the paper cited above Goebel (2), who had not at that time recognized gemmae in *Ricella*, correctly considered the young plant of *R. Battandieri* represented in his own first figure as having originated from a brood body of some sort. It is noted then that both gemma and gemmaling were figured before either was recognized, and that the early figures of gemmalings were recognized as such by later writers before the actual discovery of the gemma of *Ricella*.

As was to be expected, the early workers misinterpreted the morphological structures found in the gemmaling much as they had misunderstood those of the sporeling (7). Thus Goebel (2) first thought that the primary thallus represents the future wing; and Howe and Underwood (4) thought they were studying a gemma of

*Riella americana*, whereas the structure under observation was a young gemmaling with the isthmus elongated into a short pillar. A part of the technical description given by the latter writers of the nearly mature gemma is not applicable to the brood body but applies in reality to the gemmaling (9).

Porsild (6) also thought incorrectly that the mature gemma has an elongated isthmus, and he misinterpreted the origin of the primary rhizoids. Nevertheless, he accurately described without much detail some of the major points in the development of the gemmaling. He also called attention to the fact that later developmental stages are nearly identical whether a young plant of *Riella Paulsenii* took its origin from a spore, a gemma, or an adventitious shoot. Other writers (3, 15) concurred in this general observation.

Goebel (3) sketched the major outline of growth and development of the gemmaling of *R. Cossoniana*, although much of the desired detail is lacking. Douin and Trabut (1) represented several stages in the development of the gemmaling of *R. numidica*. Vrabner (14) found only few differences in the several species of *Riella* investigated as to the method of germination of the gemma. Young gemmalings were very briefly discussed for *R. numidica* and *R. sersuensis* by Trabut (13). Wigglesworth (15) described some of the events in the development of the gemmaling of *R. echinospora*.

Studhalter and Cox (9) described the origin and development of the gemma of the American ruffle plant, *Riella americana*, to its maturity and coined the word *gemmaling*. The present paper begins with the "germination" of the gemma and is in many respects a continuation of the former. In the following pages reference will also be made frequently to an earlier paper by Studhalter (7) on the spore and sporeling, mainly for the sake of comparing similar stages in gemmaling and sporeling.

*Materials and methods.*—The materials and methods used were essentially the same as those reported in the papers by the same authors on the gemma (9), the lateral leaf scale (10), and the ventral scale (11). Both living and preserved materials were used. Simple methods of dissection and observation prevailed, some of the points being checked from cultures, by means of stained whole mounts, and by sections of gemmalings embedded in paraffin.

*Abscission of gemma and its behavior.*—At the time of abscission from the parent plant, the gemma of *R. americana* is composed of

three parts (9): a large proximal lobe which had been attached to the axis of the parent plant by a single attachment cell; a short isthmus 1 to 3 cells long and 9 to 12 cells wide; and a smaller distal lobe containing a papillose mucilage cell and 6 to 12 large primary rhizoidal initial cells. The gemma is unistratose throughout except for the attachment cell and the papillose mucilage cell, both of which were displaced by overgrowth of adjacent cells rather than by cell division in the third plane.

Upon detachment from the parent plant, the gemma of *R. americana* sinks in the water at a slow rate. Since no part of the gemma greatly exceeds other parts in weight, no region necessarily leads during the sinking. Frequently one lobe may be in the lead for a time, and then the other; there is, however, a tendency for the large proximal lobe to occupy a slightly lower position during the descent than the smaller distal lobe. In any event, sinking is slow. Since the convex surface of the gemma is often lowermost, it is this surface which frequently makes contact with the sandy or gravelly substrate. Hence contact is readily made by the smaller distal lobe in spite of the fact that the entire gemma is slightly cup-shaped.

Very often, however, gemmae do not sink to the bottom at all, but become lodged on the various irregular surfaces of the parent or of adjacent plants. Germination and growth quite frequently take place while in this position. A large part of the gemmalings studied were perched in this manner, with the rhizoids dangling in the water far above the substrate. In view of this behavior, it does not seem that the method of sinking of the gemma in the American ruffle plant is of fundamental significance.

Porsild (6) noted that the mature gemma of *R. Paulsenii* rises to the surface and floats on the water after breaking away from the axis. He attributed its lightness to its mucilage content and considered the process of importance in the dissemination of this aquatic plant. In *R. Cossoniana*, Goebel (3) found the distal lobe of the mature gemma to contain much more starch than is found in the larger proximal lobe, making the former heavier than the latter. The mature gemma sinks to the bottom with the smaller distal lobe in the lead; at the bottom, this lobe serves as a small anchor, while the large proximal lobe stands in a more nearly vertical position. The gemmae of *R. echinospora*, according to Wigglesworth (15), sink to the bottom after detachment.

*Reversal in direction of growth.*—The fact that the initial cells of the primary rhizoids are located in the distal lobe rather than in the proximal has foreshadowed a future reorientation of the parts of the gemma with reference to apex and base. The former distal lobe comes to occupy a basal position and it fastens itself to the substrate by the developing primary rhizoids; henceforth it constitutes the actual base of the gemmaling. The proximal lobe, on the other hand, assumes a more or less elevated position and later gives rise to all of the upper parts of the gemmaling. The smaller lobe now supports a raised larger lobe, and their relative positions are completely reversed. The ensuing direction of growth is likewise reversed. Once before there had been a shift in the expected direction of growth, for during an early stage in the development of the gemma the normal forward growth was for a time retarded and a vigorous backward growth substituted for it (9). Such complete reversals in the direction of growth are not known to us in any other genus of liverworts. It follows from the above that all figures in the present series of papers on the gemmaling are inverted as compared with those in the paper on the gemma (9).

The elevated position of the proximal lobe is explained in part by the longitudinal curvature of the mature gemma, and in part by subsequent differential upward growth after the primary rhizoids have anchored the former distal lobe to the substrate. In the case of gemmae which are lodged on other plants, the correct vertical position is attained by subsequent unequal growth.

*New terminology.*—Reversal in direction of growth necessitates a new terminology for the structures developing from the gemma. The terms proximal lobe, isthmus, and distal lobe should be restricted to the three parts of a gemma, while new descriptive terms are needed for them and their derivatives in the gemmaling. The distal lobe becomes the *rhizoidal lobe*, the isthmus becomes the *pillar* or *column*, and the proximal lobe may be known as the *growth lobe*, since it later shows considerable increase in size as compared with the rhizoidal lobe.

## II. EARLY DEVELOPMENTAL STAGES

Although a true rest period is not necessary for the gemma of *Riella americana*, there is a very short cessation or slowing down of cell division until the detached gemma becomes stationary in its new position. Its "germination" is scarcely more than a continuation of



growth. Each of its three regions is involved, but in different ways. Activity begins simultaneously in the three regions, or it may start a little earlier in any one of them. The rhizoidal lobe loses little time in developing rhizoids with which the plant is anchored in the substrate. Almost simultaneously with this activity, the pillar and the growth lobe begin a long series of cell divisions, to be followed later by cell enlargements. Once firmly anchored, the rhizoidal lobe slowly loses its color and disintegrates, while the other two regions continue development to form both juvenile and adult structures.

#### THE RHIZOIDAL LOBE

At the beginning of its activity, the rhizoidal lobe has an average length of 255  $\mu$  or 16 cells and an average width of 360  $\mu$  or 25 cells.

*Primary rhizoids.*—The rhizoidal initial cell has been described (9) as a large cell with a prominent nucleus, dense cytoplasm, rather uniformly thickened cell walls, and as lacking its former chloroplasts. At the time of abscission of the gemma, the outer free wall is slightly elevated, dome-like, above the general level of the surrounding cells on one or both surfaces of the lobe. On gemmalings in contact with the substrate, the rhizoidal initials probably develop only from the side in contact. On perched gemmalings, on the other hand, they develop on either side, or even on both sides in the same gemmaling.

All rhizoids which have their origin from rhizoidal initial cells of the rhizoidal lobe are designated as primary rhizoids. No other cells are involved in their production. In the American ruffle plant, not necessarily all of the 6 to 12 rhizoidal initials develop into rhizoids, but usually half or more of them do. The young gemmaling is probably less well anchored by its several primary rhizoids than is the young sporeling with its single rhizoid of primary order (7), since the former young plant is so much larger than the latter, and has a large growth lobe to support.

A rhizoidal initial cell bulges outwards to form a short colorless tube into which the nucleus and much of the cytoplasm migrate. The tube increases in length at its hemispherical tip, where the wall is thicker and quite hyaline. Small oil drops of unequal size develop in all parts of the tube, which is positively geotropic. Its maximum length varies, but at maturity its protoplasm is no longer visible, if present at all. No cross walls have been found, as was occasionally the case in the sporeling (7), the entire rhizoid being an extension of



its initial cell. At its base, the tube tends to have the same shape and size as the free surface of the cell from which it originated; it is therefore somewhat angular and relatively large. Only a short distance from the lobe, however, it is reduced to a cylindrical structure the diameter of which is less than that of the initial cell. Its diameter is approximately  $25\ \mu$ . It is smooth throughout, with no tendency toward irregularities or pegging. With the exception of the shape at the very base of the tube, there is no observable structural difference between the primary rhizoid of the gemmaling and that of the sporeling.

*Other changes in rhizoidal lobe.*—Of the many cells of the rhizoidal lobe, only the initial cells of the primary rhizoids show any pronounced change. The cells near the pillar may be somewhat distorted and may have their walls shifted as the isthmus elongates (fig. 7), but these changes are slight. There are no further cell divisions in any of the cells, except occasionally in some of those very near the elongating isthmus. All other cells of the lobe, even the papillose mucilage cell, remain essentially unchanged. Soon after the process of anchoring is complete, however, a slow disintegration sets in at the margins of the lobe; since this phenomenon is more clearly in evidence at a later time, it will be discussed in the second paper under the present title.

#### THE COLUMN OR PILLAR

The isthmus of the mature gemma has previously been described (9) as a very short structure which is 1 cell thick, 1 to 3 cells long, and 9 to 12 cells wide. It is often so short that the edges of the rhizoidal and growth lobes overlap each other. It contains no marginal mucilage cells; in fact, its cells are nearly identical, small, definitely meristematic, and have a tendency to be rectangular in shape and arranged in vertical rows. They are as green as virtually all other cells of the gemma.

Growth activity of the isthmus sets in at the time of the appearance of the primary rhizoids. At times it begins even earlier (fig. 1), a phenomenon which no doubt accounts for the error of Howe and Underwood (4) in mistaking the young gemmaling having a short pillar for a mature gemma. Development of the column is roughly divisible into two overlapping phases, one in which cell division is greatly dominant over cell elongation, and a later one in which the reverse is true.

*Phase of cell division.*—In the early part of the first phase, cell divisions are almost exclusively in parallel planes, the new cross walls being laid down in the direction of the width of the isthmus (figs. 2, 7). The diameter of the resulting cells in the transverse direction of the pillar is usually  $1\frac{1}{2}$  to 2 times that in its long direction. The net result is an elongation of the pillar which is now composed of small, green, very active, meristematic cells. When the column is 7 or 8 cells long (fig. 8), the excessively meristematic nature of its cells is a little less evident; many of them have elongated slightly to become nearly isodiametric. This is the beginning of a long wave of cell elongation which begins at the base of the young pillar and progresses slowly in acropetal succession. The wave is most pronounced in the middle vertical zone of the pillar, and considerably less at the margins. Hence, in all future stages until the column has nearly reached its maximum length, the cells which are longest in a vertical direction are found at the base of the middle vertical zone of the pillar, and they are progressively shorter upwards; 1 or 2 rows of marginal cells remain shorter than interior cells; and the smallest, most strikingly meristematic cells are those at both upper corners of the pillar.

Cell division is practically restricted to a single direction. Only at the upper corners of the column is there a small amount of division in other directions, resulting in a slight broadening of the top, where it joins the growth lobe. The entire pillar, however, remains uniformly one cell in thickness.

The phase during which cell division is dominant over cell elongation is a short one. Its net result is best seen in a pillar about 10 cells long in the middle vertical zone (fig. 9). The column is now just as long as wide; the width is nearly uniform, with a slight flaring out at each side of the very top. The cells are mostly arranged in rather clean-cut longitudinal rows, except at the upper corners. They are for the most part rectangular, slightly elongated in the lower part of the middle vertical zone, isodiametric in other regions, and quite short at the upper corners. At the lower end of the column is found the relatively little changed rhizoidal lobe, and at its upper end the elongating growth lobe.

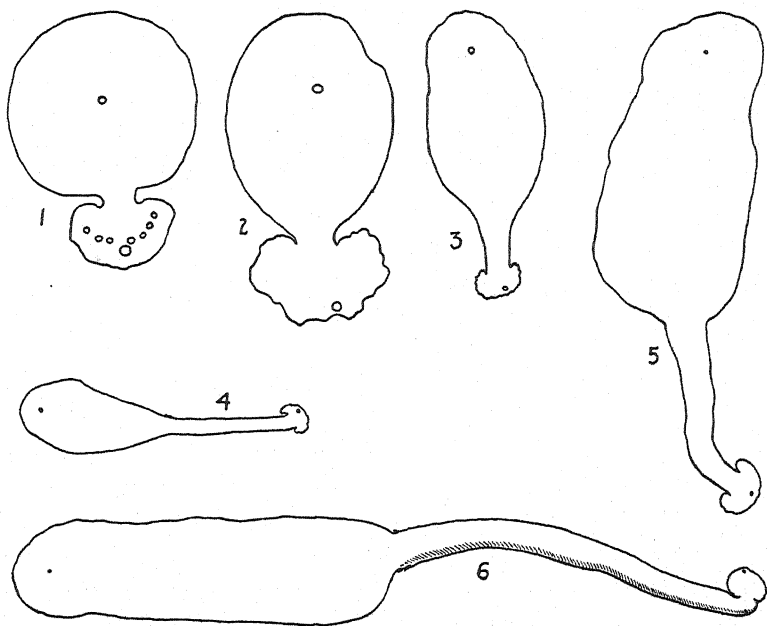
*Phase of cell elongation.*—The second growth phase (figs. 3 to 6) is of much longer duration than the first. Although cell elongation is dominant over cell division from the time the pillar is 10 or 12 cells long until it reaches its maximum length, and the more striking

changes are due to cell elongation, cell division nevertheless continues as long as the column grows. The wave of cell elongation described above as extending acropetally continues with greater magnitude, the cells at the base of the middle vertical zone elongating most and those at the upper corners least. In any given region of the pillar there is an inverse ratio between the amount of cell elongation and the amount of cell division. The length of the column in number of cells is greater at the margin than in the middle vertical zone. Its width, however, is nearly uniform, except in the upper horizontal zone, and remains nearly the same as that of the isthmus in the gemma.

In a pillar about 14 cells long at the middle vertical line (fig. 3), the basal cells are 2 to 3 times as long as wide, their width being only slightly greater than in the cells of the original isthmus. The length of the middle cells of the middle vertical zone is 1 to 2 times their width. The upper cells of the middle vertical zone are isodiametric. The marginal cells are somewhat irregular in size and shape, and the cells of the broadened upper corners have remained very short and meristematic.

In a column with a length of 25 to 35 cells along the middle vertical line (fig. 4), cell elongation is still most pronounced in the basal part of the middle vertical zone, where the cells are 5 to 8 (rarely 4 or 10) times as long as wide. The basal marginal cells have a length of 1 to 4 times their width. In the midregion of the middle vertical zone, the cells are  $2\frac{1}{2}$  to 5 times as long as wide. The upper cells of this zone are generally isodiametric, and the cells of the upper marginal regions have remained small and meristematic. The upper zone of small cells is now short, about  $\frac{1}{10}$  the total length of the pillar, and the wave of cell elongation has progressed to near the top of the pillar. In width the pillar is now usually 15 to 30 cells at the upper end (only 9 in fig. 4), 10 to 13 cells at the middle, and 9 to 12 cells at the base; in other words, there has usually been no appreciable widening except at the top. Secondary rhizoids and marginal mucilage cells, which will be discussed later, are present.

*Column of maximum size.*—Porsild (6) believed that the column of *R. Paulsenii* continues to elongate until the gemmaling reaches the surface of the water. In the American *Riella* this is not the case, for most of the mature plants are far below the surface of the water. There is some evidence, however, to indicate that the column becomes longer when the gemmaling is anchored in deeper water, and the reaction is believed to be a response to light.



Figs. 1-6. *RIELLA AMERICANA*. Figs. 1, 2,  $\times 40$ ; figs. 3-6,  $\times 12$ . Rhizoids are omitted in all drawings. 1. Very young gemmaling, showing smaller rhizoidal lobe with papillose mucilage cell and 7 initial cells of the primary rhizoids, the slightly elongated column or pillar, and the larger growth lobe (larger than average) with the remains of the former attachment cell; first growth in pillar. 2. Slightly older gemmaling, showing greatest amount of growth in growth lobe. 3. Still older gemmaling. 4. Gemmaling in early "tennis-racquet" stage; rhizoidal lobe 10 cells long and 15 cells wide; pillar 25 cells long and 9 cells wide; growth lobe (small for this stage) 55 cells long and 35 cells wide at widest part. 5. Gemmaling approaching maturity in which the growth lobe shows much more growth than the pillar. 6. Gemmaling in mature "tennis-racquet" stage; rhizoidal lobe 9 cells long and 15 cells wide; pillar, turned sharply upwards at its junction with the growth lobe, 30 cells long in middle vertical zone, 9 cells wide at junction with rhizoidal lobe and 20 cells wide at top; several young scales at top of pillar; shaded zone shows extent of axis (3-5 cells wide); growth lobe 115 cells long and 55 cells wide.

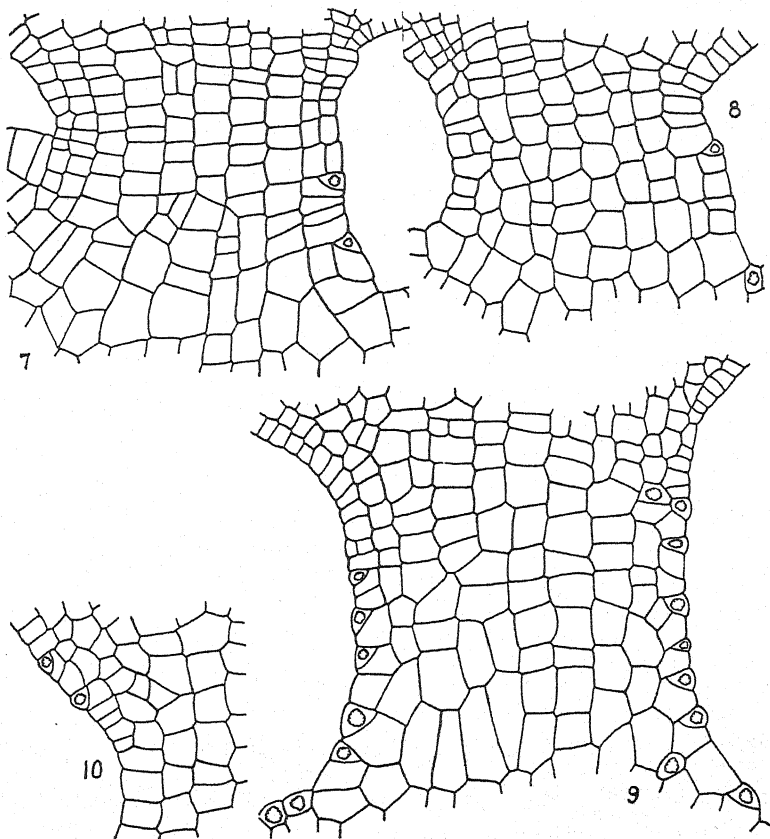
At its maximum length (fig. 6), the column varies from 25 to 35 cells long at the middle vertical line; on rare occasions the length may be 50 or 60 cells. It may have grown in a straight line, but more usually is bent near its base to make adjustment to its negative geotropism. Its width is often 30 to 40 cells at the top, 12 to 15 at the middle horizontal region, and still scarcely more than its original

9 to 12 cells at its base. Among the few exceptions, one well developed gemmaling was found to have a pillar width of only 3 cells. Cell division and elongation have been almost wholly in a vertical direction and most of the cells have retained their position in long vertical rows. At the top, where there remain many meristematic cells, the cell rows are indefinite or absent. In thickness the pillar remains uniformly unistratose. The margin is not always smooth; frequently some of the cells of a marginal row divide with vertical cross walls to form a double marginal row, with a greater combined width than that of the single row; they then occupy a staggered position with reference to the single row above or below them (fig. 8). Such staggering may occur three or four times in a single pillar.

At the maximum length of the column, nearly all cells are elongated except those of the two upper corners; the wave of cell elongation stops without involving these cells. The longest cells are still to be found in the lower two-thirds or three-fourths of the middle vertical zone, where they may be 5 to 10 times as long as wide. The width of these large cells varies little and is only slightly greater than that of the original cells of the isthmus. The cells in the upper portion of the middle vertical zone are 1 to 2 (rarely 3) times as long as wide. Cells of the marginal row have a length of 1 to 2 times their width. All mature cells of the column have the cytoplasm located in a thin peripheral layer, leaving a large central vacuole. No distinct areas of meristematic cells remain except at one or both upper corners. In color, the pillar is much lighter green than either of the lobes, due to the spreading of the chloroplasts in each cell over a larger peripheral area. It is usually difficult to draw a line separating the column from the enlarged growth lobe.

Marginal mucilage cells, completely absent in the isthmus, are first formed when the pillar is 10 to 12 cells long, or rarely a little earlier (figs. 7, 8). Their number varies considerably in older pillars. In one mature column only 8 were found in the entire pillar, while in another there were about 30 on each side; 10 or 12 is a common number for each margin. Mucilage cells in the pillar appear to be rather evenly distributed on the margins, to be present only in the marginal row, and to be cut off only from the distal end of a marginal cell. Their structure does not differ from that described earlier (9). Non-marginal mucilage cells are rare (fig. 9).

All of the cells of the pillar thus far considered belong to juvenile



Figs. 7-10. *RIELLA AMERICANA*.  $\times 230$ . Mucilage is shown diagrammatically by a wavy line. 7. Slightly elongated pillar showing small meristematic cells near margins, isodiametric cells in middle vertical zone, and the first marginal mucilage cells cut off from the distal outer corner of two marginal cells; unequal growth associated with twisting of pillar toward the vertical; cells arranged in vertical rows. 8. Slightly longer pillar with an extra staggered row of cells on one side. 9. Pillar about 10 cells long in middle vertical zone, showing the beginning of the acropetal wave of cell elongation and numerous marginal mucilage cells. 10. Junction of pillar (below) and growth lobe (above) showing the occasional definite boundary between these structures just below the residual marginal meristematic cells of the growth lobe.

structures. Before (sometimes long before) the pillar reaches its maximum length, structures develop which belong to the adult plant, such as secondary rhizoids and the axis. Since, however, these take us beyond the juvenile stages, they will be described in the second paper under the present title.



## THE GROWTH LOBE

Returning to the mature gemma, it was found that a vigorous proximal lobe, later to become the growth lobe, has a length of 32 to 40 cells with a width of 40 to 50 cells. It is nearly circular in shape, a little shorter than wide, and is made up of relatively small, isodiametric cells which follow no definite pattern of arrangement, except that the cell rows of the isthmus extend a short distance into it and that the marginal cells form a continuous row. Marginal mucilage cells are already fairly abundant. With the anchoring of the gemma, the growth lobe already occupies a more or less erect position. Both in time and in space, one can hardly separate the growth activities of the lower part of the growth lobe from those of the upper part of the column.

Developments in the growth lobe, like those in the pillar, lend themselves to a reasonable division into two overlapping phases. In the first, a phase of short duration, cell division dominates the activities, while cell enlargement is secondary. In the second phase, which is of much longer duration, cell enlargement is of much greater importance than cell division in all regions of the lobe except its base. As was true in the pillar, growth occurs in two planes only, length and width, the entire growth lobe remaining uniformly one cell thick. In spite of the superficial similarities thus suggested in the development of the growth lobe and pillar, there are some striking differences in the behavior of the two regions.

*Phase of cell division.*—In this first phase of growth, cell division may occur in any plane through a line perpendicular to the lobe, but never in a plane to increase the thickness of this organ. Since the cells are not arranged in rows to begin with, it can be anticipated that cell division results in increasing both length and width of the unistratose plate of cells.

The cell enlargement which takes place during this phase at first increases both the length and width of the cells, and is better called enlargement than elongation. Throughout this growth phase, the lobe is increased slightly more in length than in width, so that it remains for a time nearly circular. The cells, also, are of a more or less uniform size, except those occupying a basal or marginal position, the former remaining small and meristematic and the latter somewhat smaller than the bulk of the body cells. From a very early stage of growth, the marginal cells at the very base of the lobe divide with

cross walls parallel with the margin. Since these cells do not increase rapidly in width, they remain for an indefinite time only half as large as the adjacent marginal cells at the top of the pillar (fig. 10). In such cases there is a very definite boundary line between the marginal cells of the pillar and those of the growth lobe. In spite of additional cell divisions, this condition often continues to prevail until the growth lobe reaches its maturity. Cell enlargement does not take place simultaneously throughout the lobe, but occurs in a wave which starts near the apex and proceeds in basipetal succession. It is somewhat more pronounced in the middle vertical zone.

The phase of cell division runs almost imperceptibly into the second growth phase. At the close of the first phase (fig. 2), the lobe is almost circular or somewhat elongated. The cells of its various regions differ relatively little. Those at the base are small, isodiametric, and meristematic. The body cells near the center are a little larger and either isodiametric or slightly elongated. Those at the upper end are larger still,  $1\frac{1}{2}$  to 2 times as long as wide, and elongated more or less parallel with the long axis of the lobe. Basal marginal cells are very small. The bulk of the marginal cells are isodiametric, while those at the distal end are often twice as long as wide, with their long axes parallel with the margin (hence at right angles with the long axis of the lobe). Chloroplasts are close together in isodiametric cells and much further apart in the newly elongated cells.

*Phase of cell enlargement.*—This growth phase (figs. 3 to 6) is of much longer duration than the earlier phase. The wave of cell enlargement and elongation continues toward the base of the lobe. Although the cells are not arranged in rows, they have a tendency to elongate in planes nearly parallel with the long axis of the gemmaling. The result is an increase in the length of the lobe, with a little addition to its width. Its sides usually become straight and nearly parallel with each other; in other cases the distal half, or in still others the middle horizontal zone, becomes broader than the rest of the lobe. The shape of the top changes from a half circle to an elongated, rounded dome.

Early during the phase of cell enlargement, localized cell divisions (not elongations) are responsible for a slight lengthening of the base of the lobe, which becomes narrowly or broadly cuneate or more rarely somewhat rounded at one or both sides. Its cells remain small and meristematic, even when the lobe has reached its maximum length.

*The mature growth lobe.*—At its maturity, the growth lobe is nearly vertical in position, and is usually straight in form, although it, like the pillar, may be curved on its long axis. The margin is smooth. The size of the lobe varies from 2 to 8 times its original length and it is usually  $1\frac{1}{2}$  times its original width. It may reach 80 to over 100 cells in length and have a maximum width of 40 to 55 cells; 115 by 55 and 100 by 80 are the figures for two large lobes. Its general shape is narrowly ovate or less frequently obovate with somewhat irregular, coarsely wavy, slightly indented sides; on rare occasions it is oval or nearly spatulate.

The size and shape of the cells of the mature growth lobe vary according to their position in the lobe. The basipetal wave of cell division has reached almost to the base. All body cells except the basal ones are now elongated in the general direction of the long axis of the lobe, and are  $1\frac{1}{2}$  to 2 times as long as wide. Basal body cells are isodiametric and less distinctly meristematic than when last described. Distal marginal cells have changed little. Many of the cells of the lateral margin have elongated to  $1\frac{1}{2}$  times their width. The basal marginal cells may be alike on both sides of the lobe, in which case all have remained quite small and meristematic. More frequently, however, the marginal cells at one side lose their meristematic character and enlarge equally in length and width, while those at the other margin remain quite small and meristematic. The reduced elongation and smaller number of cell divisions, as compared with those of the pillar, are responsible for the fact that the mature growth lobe attains a maximum length of only 2 to 8 times its original length.

Simultaneous waves of cell elongation have started at opposite ends of the pillar and growth lobe and have progressed in opposite directions. In the former it has progressed upwards, while in the latter it has gone downwards. In each case the wave stopped before the other end of the organ was reached. Thus the two waves, which have tended to converge at the junction of the pillar and growth lobe, have failed actually to meet, and have left a zone of smaller cells at the junction of pillar and lobe. Most of these cells have matured into isodiametric cells which are larger than the original meristematic cells. At one or both margins, however, they have remained quite embryonic. It is in this important region of cells capable of further rapid growth that the major activities associated with the develop-

ment of the structures of the adult plant take place; this discussion, however, belongs in the next paper.

Early writers had looked for an apical master cell at the distal end of the growth lobe of the gemmaling and of the primary thallus of the sporeling, under the erroneous idea that it is these cell plates which grow directly into the structures of the adult plant. No such cell is present in the growth lobe, any more than it is in the primary thallus (7), with which it is homologous.

Marginal mucilage cells, already numerous in the proximal lobe of the gemma, increase in number with the enlargement of the growth lobe. At maturity of the lobe there may be 50 to 120 such cells. Some mucilage cells are also found away from the margin, mostly in the second or third row from the outside, but occasionally at any other point in the lobe. Such non-marginal mucilage cells, although not common, may rarely number from 20 to 100. They are usually isolated from each other. There are also occasional empty cells in the lobe.

The attachment cell, that is, the single cell which had attached the gemma to the axis of the parent plant, if it has remained on the lobe at the time of dehiscence, remains attached to the growth lobe indefinitely. It loses its density and becomes brownish in color in the early stages of the gemmaling, but otherwise remains relatively unchanged. On the mature growth lobe it occupies a central position with regard to the arc of the distal margin of the lobe, 12 to 25 cells removed from the top and sides.

Most of the lobe retains a bright green color until it reaches its maturity. However, the processes of resorption and disintegration, to be described in the next paper, set in near the tip of the lobe at an early stage of its growth and may continue slowly. All cells not involved in this process retain bright green chloroplasts.

#### GEMMALING IN "TENNIS-RACQUET" STAGE

In one sense, the gemmaling (fig. 6) can now be called "mature," since all of its juvenile structures (rhizoidal lobe with primary rhizoids, pillar, and growth lobe) have reached their maximum size and maturity. The major permanent structures of an adult *Riella* plant (axis, wing, permanent growing point, scales, gemmae, and sex organs) have not yet been formed; these arise as new outgrowths or as new structures formed otherwise from one or another of the parts of the

mature gemmaling described above. It is true that the formation of the first three of these is begun before the juvenile structures reach maturity, but these early stages are ignored here. The present article closes with such a mature gemmaling, which has a shape resembling a paddle or a tennis racquet; the development of some of the major permanent structures of the adult gametophytic plant constitutes the material of a second paper under the above title. A mature sporeling was also found (7, 8) to resemble a paddle or tennis racquet.

The gemmaling at this "mature" stage is composed of three regions: a small rhizoidal lobe normally attached to the substrate by primary rhizoids; a narrow, much elongated pillar or column; and an enlarged growth lobe. The three regions are uniformly one cell in thickness, the only apparent exceptions being the remains of the displaced attachment and papillose mucilage cells. The rhizoidal lobe is normally appressed to the substrate; the other two regions stand more or less vertically in the same plane. On gemmalings which are lodged on other plants, the three regions often stand rigidly in one plane. Bending, which results in bringing the gemmaling to a more nearly vertical position, is common; in a single plant it usually occurs along only a single axis and in only a single plane.

Color varies considerably in the several regions of such a gemmaling. The rhizoidal lobe, which has partially disintegrated, has lost most of its green color. The column has become a lighter green than formerly, since its chloroplasts have become more widely separated in the elongated cells. The growth lobe is the brightest green of the three regions, only the small part of the lobe which has begun to disintegrate having lost its chloroplasts.

There is considerable variation in the maximum size attained by gemmalings with mature juvenile structures. The rhizoidal lobe is actually smaller than at the time of detachment of the gemma. The pillar has increased enormously in length but very little in width. The growth lobe has grown less in length but more in width than the pillar. Over all, the gemmaling in the mature "tennis racquet" stage may be nearly 9 mm. in length and 1.25 mm. in maximum width.

Growth in the gemmaling does not cease at this stage, but continues uninterruptedly into the next stages, during which permanent structures of the adult plant are formed. These same later stages, to be discussed in a future paper, see the disintegration of many of the juvenile structures which in this paper have been brought to their maximum development.

## SUMMARY

The gemma of *Riella americana* continues growth after abscission without a rest period. The direction of growth of the gemmaling is the reverse of that in the early developmental stages of the gemma. The rhizoidal lobe (formerly distal lobe) develops primary rhizoids and becomes anchored. The column or pillar (formerly isthmus) increases enormously in length by means of a growth phase of cell division followed by one of cell elongation. Most of its cells become greatly elongated. The growth lobe (formerly proximal lobe) passes through the same two growth phases, and increases both in length and width.

The resulting gemmaling has a paddle or tennis-racquet shape, is green, unistratose, and has all of its parts, which are juvenile structures, located in a single plane. It is ready for the formation of structures belonging to the adult plant, many of which will arise from a residual group of intercalary meristematic cells at the junction of pillar and growth lobe.

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A NEW SPECIES OF *POGONATUM* FROM MEXICO

CLARA J. KELLY

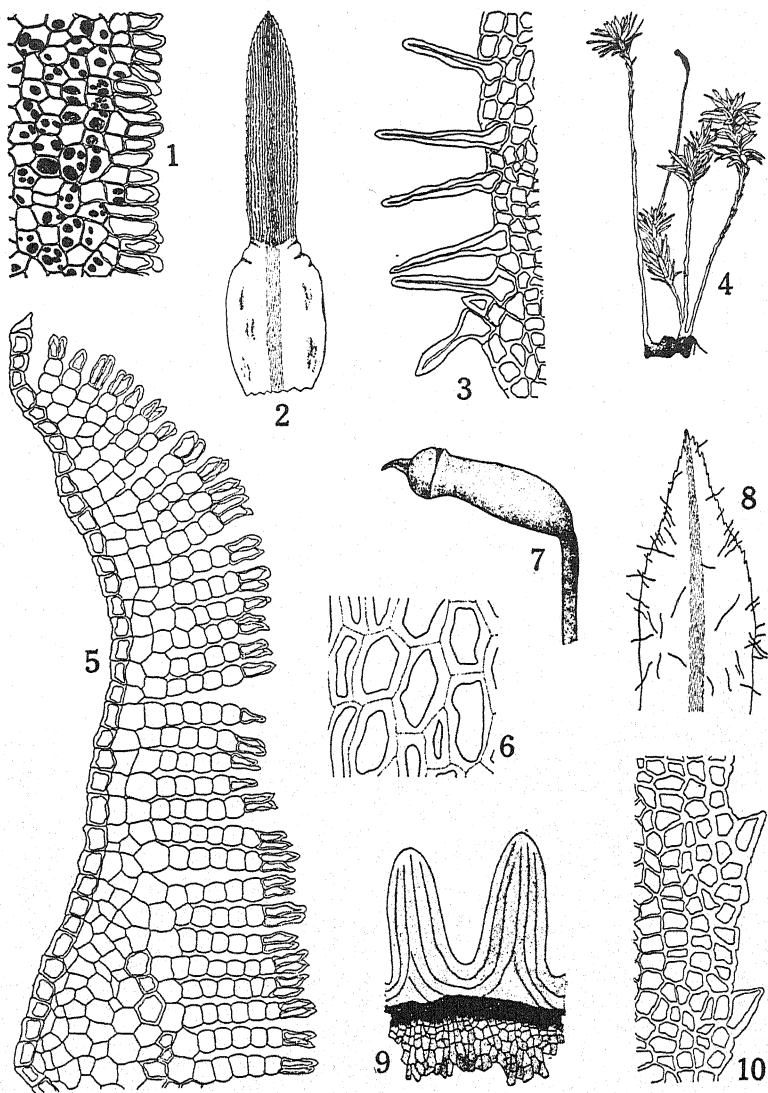
In the examination of a number of Polytrichaceae gathered in Mexico, a *Pogonatum* of unusual interest was found to have the marginal cells of the lamellae paired, as well as having many long, stiff hairs on the bracts. Further examination did not place it properly in any known species. The following is a description of our material:

*POGONATUM hirtellum* n. sp.

Uno sexu praeditum, caespitosum, rufescens. Caulis erectus, simplex, ad 7 cm. altus. Folia lanceolata, serrata prope ad base, costa dorso superne dentata; lamellis numerosis 60-70, totam partem angustioris folii latitudinem occupantibus, margine canaliculata dentatis, in sectione transversali 4-7 cellulis formatis, quarum 2 marginalibus geminatis, apice liberis et levibus. Bractee subfoliis serratae, hirsutae, costa supra basem, sine lamellis; capilli unae cellae; cum densis muris, hyalini, 60  $\mu$ -300  $\mu$  longi, eminenti ex cellis epidermidis. Planta masculina feminae similis. Seta ad 4 cm., rubra, apice tortilis, horridula. Theca teres, ad 7 mm.; sine stomatis; operculum breviter conicum, cum rostro curvato; calyptra albidula, dense pilosa, tendens ad basem thecae.

Plant caespitose, brownish to reddish green. Stems erect (Fig. 4), usually simple, 5-7 cm. high, from a subterranean rhizome: in cross section the epidermal cells large, with thick walls, isodiametric to three times as thick as wide; interior cells from one to five times the area of the epidermal cells but nearly all larger, thin walled: in longitudinal section the epidermal cells about 20-30 times as long as wide, the interior cells about 8-10 times as long as wide, dark brown, very thick walled. Rhizoids comparatively few, whitish, near base of stem only. Leaves lanceolate (Fig. 2), 7-9 mm. long, spreading when damp, appressed and slightly curved when dry, acute; lamina 4-6 mm. long, from a sheathing base, sharply serrate nearly to sheath; the non-lamellate margin erect or nearly so, one cell thick, the marginal teeth mostly one-celled (Fig. 10); cells of the back of the lamina quadrate, thick walled. Lamellae 60-70, covering almost the entire upper surface of lamina (Fig. 2), 4-7 cells high; *marginal cells paired* (Fig. 5), shortly cylindric or a few ovate, *free from one another, smooth*. Sheath entire; median cells thin walled, 4-6 times as long as wide, marginal cells much like those of the interior. Costa percurrent, with large, strong teeth on dorsal side near tip. Bracts grading into leaves above and becoming smaller toward base of stem, *hairy*, serrate, costa excurrent, lamellae lacking except in upper ones, sheath entire (Figs. 3, 8); *hairs arising as a diverticulum of a surface cell, without cross walls, 60  $\mu$ -300  $\mu$  long, unbranched, quite numerous, hyaline, very thick walled.\**

\* It is from these hirsute bracts that the name *P. hirtellum* is selected.



Figs. 1-10. *POGONATUM HIRTELLUM* Kelly. 1. Side view of lamella,  $\times 328$ . 2. Normal, well-developed leaf,  $\times 7$ . 3. Hairs on bracts,  $\times 296$ . 4. Habit sketch,  $\times 4$ . 5. Part of cross section of leaf,  $\times 272$ . 6. Epidermal cells near base of capsule,  $\times 272$ . 7. Sporangium,  $\times 6$ . 8. Bract, showing hairs,  $\times 19$ . 9. Teeth of the peristome,  $\times 72$ . 10. Portion of leaf margin, two thirds down the lamina,  $\times 296$ .

Plants unisexual. Male plants comparable with the female in size, with discoid inflorescence at tip; rejuvenating from the tip so that one finds up to four successive discs, probably representing successive years of growth. Male bracts about 2 mm. long and 3 mm. wide, with sheath entire; narrowing suddenly to excurrent vein about 500  $\mu$  wide, and representing the lamina, almost completely covered with lamellae; cells of sheath shorter than those of the leaves, yellowish-brown; cells near lamina quadrate, becoming longer than wide toward base. Antheridia short, stalked, clavate; paraphyses numerous, filamentous, composed of a row of elongate thin-walled cells. Archegonia with many more paraphyses than the antheridia; perichaetial bracts longer than the vegetative leaves, about 9 mm. long. Seta 25-40 mm. long, dark brownish red, slightly twisted clockwise a quarter to a half turn at the base when dry; its epidermal cells thick walled, elongate, nodulose; in cross section the cortex 10-12 cells thick, of very thick walled cells; interior cells parenchymatous, hexagonal, the inner breaking down before the capsule matures. Calyptra straw-colored to whitish, densely hairy, reaching to the base of capsule; hairs smooth, branched. Sporangium terete, dark brown, about 7 mm. long and 1-1.5 mm. in diameter (Fig. 7), slightly mamilllose; operculum short, cap-like, with curved beak about as long as the cap, dark brown; epidermal cells of sporangial wall rectangular, very thick, slightly mamilllose, stomates lacking (Fig. 6); columella irregularly attached to walls of the spore sac. Membrane over teeth a thin, granular, hyaline disc of irregularly rectangular cells whose outlines are very indistinct without staining; granules about 1  $\mu$  in diameter and often in straight lines resembling cell walls, or in clumps. Teeth of capsule 32, single, large, strong, with marked striations (Fig. 9). Epidermal cells of sporangium near mouth small, thick walled, blackish-brown, toward the sporangial base gradually becoming light brown, longer than wide except at upper edge. Spores about 11  $\mu$  in diameter, round, smooth, bright green, very thin walled.

The material was collected about three miles westward from Hidalgo, Michoacan, Mexico, on the clay of a cut along the highway to Moralia; latitude approximately 19° 50' N., longitude 101° W., at an elevation of about 2,000 meters by Dr. T. C. and E. M. Frye, on May 18, 1939 (collection No. 2810).

It is nearest to *Pogonatum hamatifolium* Ren. & Card. which has the paired marginal cells of the lamellae papillose, while in this species they are smooth; the male plants of the former are very small, while in this they are nearly equal to the female; the lower leaves of *P. hamatifolium* are noticeably cucullate at the apex, while in this species they are not. Hairs other than rhizoids are nowhere mentioned in any description which we have seen, while in our Mexican material the stiff hairs are a distinct microscopic feature.

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NOTES ON THE WARNSTORF SPHAGNUM HERBARIUM II:  
THE SECTION MALACOSPAGNUM

A. LEROY ANDREWS

Whether one calls this group of *Sphagnum*, as I have done, section *Malacosphagnum*, following Carl Müller's terminology, or prefers subsection *Rigida*, following Warnstorf, there will be no great disagreement as to its delimitation, for it appears to be an essentially natural group of relatively few species, marked by the general characters indicated in my previous article and constituting, as I there endeavored to show, that group of the subgenus *Litophloea* which lies closest to the other subgenus *Inophloea* (*Cymbifolia*). As to the number of species which it contains there has been however greater fluctuation, even within the works of Warnstorf himself. In the first edition of Engler and Prantl's *Natürliche Pflanzenfamilien*,<sup>2</sup> Warnstorf enumerated and in part distinguished by key 18 species from various parts of the world. Later in his detailed treatment in Engler's *Pflanzenreich*<sup>3</sup> he had reduced the 18 to 7 (with a considerable number of varieties), adding a species, *S. Mildbraedii*, published by himself in 1910, making a total of 8. In the second edition of *Natürliche Pflanzenfamilien*,<sup>4</sup> after Warnstorf's death, H. Paul included the same 8 species without critical appraisal, only following my substitution of the older name *S. strictum* Sulliv. for the *S. mexicanum* Mitt. of Warnstorf. The number of species can, in my opinion, be somewhat further reduced. But let us first note the changes which Warnstorf's studies of ten years (1901-11) led him to make and which, it may be added, were for the most part correctly made.

*S. compactum* DC., the common species of the north temperate zone, was left intact.

*S. vulcanicum* Warnst. (1900), from the Hawaiian Islands, was reduced to an unimportant variety of *S. Wheeleri* C. M. (1887), from the same islands, to which *S. rigidulum* Warnst. (1890) had been reduced already in 1901.

*S. Garberi* Lesq. & James (1879) was included as a synonym under *S. mexicanum* Mitt. (1869).

*S. sparsifolium* Warnst. (1894), said in 1901 to be from Guadeloupe,

<sup>1</sup> For I see *Annales Bryologici* 9: 3-12. 1937.

<sup>2</sup> 1(3): 253 f. 1901.

<sup>3</sup> *Sphagnologia Universalis* 143 ff. 1911.

<sup>4</sup> 10: 115 f. 1924.

was in 1911 included as a variety under *S. Pappeanum* C. M. (1849), from Africa, with the explanation that the specimen had been African rather than American, and *S. Bescherellei* Warnst. (1890) (*S. patens* Besch. 1881, not Brid. 1806), though treated as one of the 8 independent species, was stated to belong probably also to *S. Pappeanum*. *S. lacteolum* Besch. (1875), from Amsterdam Island, was also reduced to *S. Pappeanum*.

The greatest reduction, however, was under *S. antarcticum* Mitt. (1859) of the Australian and New Zealand region. Here were placed as synonyms or inconsequential varieties *S. australe* Mitt. (1860), *S. macro-rigidum* C. M. (1887), *S. Helmsii* Warnst. (1890), *S. erosum* Warnst. (1890), *S. guatemalense* Warnst. (1890), which had erroneously been thought to have come from America, *S. macrocephalum* Warnst. (1893), and *S. densicaule* Warnst. (1900), all of which had in 1901 been included as independent species.

*S. rigescens* Warnst. (1898) was, like *S. compactum*, left intact.

Of the 8 species thus left in the group, one of them (*S. Bescherellei*) questioned as to its independent value by Warnstorf himself, *S. rigescens* Warnst. should be excluded, as I have already intimated in my first article.<sup>5</sup> The plants do not at all resemble outwardly the other species of the group, as Warnstorf noted. They consist, in the Warnstorf herbarium, of 2 specimens from the same locality;<sup>6</sup> both have the same number 273, but one is labeled as collected in March, the other in April. They are quite alike, evidently to be regarded as duplicates, very likely taken from the same tuft. They are frankly somewhat puzzling and I examined them a number of times before I became convinced that they are probably abnormally or imperfectly developed *S. magellanicum* Brid. Certainly they are hardly referable to the section *Malacosphagnum*.

Of the other 7 species, one of them questioned by Warnstorf, it is very doubtful if *S. Wheeleri* C. M. from the Hawaiian Islands is really distinct from *S. compactum* DC., the common species of the north temperate zone. It has the same leaf-section and other characters generally. Noteworthy are on the dorsal surface of the branch-leaves the remarkable development of what Warnstorf called "pseudopores," viz., the connection of the transverse "fibrils" of the empty leaf-cells by secondary fibril-bands at right angles to them, giving the effect of a series of pores adjacent to the chlorophyll cells, a large

<sup>5</sup> Ann. Bryol. 9: 5. 1937.

<sup>6</sup> Puerto Angosto on Desolation Island in Tierra del Fuego, leg. Dusen 1896.

part of them showing, however, no actual punctures. This condition is present in ordinary *S. compactum*, but normally not in such high degree. In the *S. vulcanicum* Warnst. also from the Hawaiian Islands, which Warnstorf reduced in 1911 as a variety to *S. Wheeleri*, this condition is hardly as marked as in ordinary *S. compactum*, so that it seems quite probable that the Hawaiian specimens may all be included in *S. compactum* DC. The Hawaiian Islands do not otherwise show an independent *Sphagnum* flora.<sup>7</sup>

*S. strictum* Sull. (1845), which Warnstorf called by the later name *S. mexicanum* Mitt., appears to be adequately separate from *S. compactum*, though one sometimes experiences a little trouble in determining imperfectly developed specimens. The most prominent diagnostic mark is the position and form of the chlorophyll cells of branch-leaves as shown in cross-section, which in *S. compactum* are central and entirely included, while in *S. strictum* there is a distinct exposure on the dorsal surface of the leaf and the inner walls of the empty cells where in contact with the chlorophyll cells are generally minutely papillose. The so-called "pseudopores" of the leaves of *S. compactum* are also completely lacking in *S. strictum*. *S. strictum* is apparently an old species and has a distinctly "relict" distribution, corresponding only in small part with that of *S. compactum*. I have already discussed it briefly<sup>8</sup> as an Atlantic species, it having a broken distribution along the Atlantic coast of North America from Newfoundland (Labrador?) to Florida, Alabama and Louisiana. The isolated stations south of the United States, which fall entirely out of the range of *S. compactum*, are all at altitudes of roughly 1000 to 3000 metres and are from San Domingo of the West Indies (*S. domingense* C. M. 1898), Oaxaca, Mexico (*S. mexicanum* Mitt.), with a second Mexican specimen noted by me in the herbarium of the Copenhagen Botanical Garden,<sup>9</sup> and finally with immature fruit in the province of Oriente, Ecuador, leg. Allioni, 1909. The specimens from San Domingo and Ecuador I saw in Berlin and would agree entirely with Warnstorf in including them in this species. In Europe the range has been recently extended from the western Norwegian localities, where it is well represented, to the western coast of the British Islands, in-

<sup>7</sup> Cf. Bartram, *Manual of Hawaiian Mosses*, 11f. 1933. This holds generally for the small island groups of both the Atlantic and Pacific Oceans, for example *S. nitidulum* Warnst. from the Azores is evidently *S. capillaceum* var. *tenellum* (Schimp.) Andr. (= *S. rubellum* Wils.) and *S. Godmanii* Warnst. also from the Azores is *S. Girgensohnii* Russ.

<sup>8</sup> *Ann. Bryol.* 11: 16. 1938.

<sup>9</sup> *THE BRYOLOGIST* 16: 23. 1913.



cluding Ireland, to a few localities in western and southern Sweden, a locality in the Rheinland of Germany noted by Schumacher<sup>10</sup> and finally a more dubious even more southern European locality given by Warnstorf in 1911,<sup>11</sup> viz., the Grimsel in Switzerland,<sup>12</sup> questioned however by Schumacher<sup>13</sup> as to its identification. After examining the very scant specimen so labeled in the Warnstorf herbarium I wrote to Schumacher that I could see no reason to disagree with Warnstorf's identification of this specimen, at the same time calling his attention to my conception of the close relation of the African *S. Pappeanum* C. M. to this species (*S. strictum*). In a later publication, Schumacher<sup>14</sup> then reversed his first judgment upon the Grimsel specimen, now treating it as in fact *S. strictum* (f. *helveticum*, p. 151) and to some extent took the whole *Malacosphagnum* group into consideration. The identity of this supposedly Swiss specimen, which is even fruiting, can hardly be doubted, but the possibility of a mistake in the locality indicated by the label is not entirely excluded. Efforts have been made, without success, to find the larger specimen from which Warnstorf's fragment was taken. The late L. Loeske during the last year of his life tried hard to find a clue. Dr. H. Paul was extremely kind in cooperating, but as yet no further trace of this species from Switzerland has been found. Schumacher seems to have made a brief trip to the Grimsel, but without finding the plant. The locality is one of very considerable rainfall, as I noticed in traveling through it, and is one of those regions in the Swiss Alps favorable to the survival of the so-called "Atlantic" species.

*S. Pappeanum* C. M. (1849) from Africa must certainly include the *S. Bescherellei* Warnst. (1890), as Warnstorf himself suggested, and I believe also the *S. Mildbraedii* Warnst. (1910). All are African, including islands to the east and west of Africa. There is in my mind some doubt that this *S. Pappeanum* is really specifically distinct from *S. strictum*, but I do not feel justified in making an absolute reduction. The plants are generally more robust with the appearance otherwise of *S. strictum*, the chlorophyll cells of branch-leaves are less strongly exposed on dorsal surface, but not so completely enclosed as in *S. compactum*, the inner walls of empty cells enclosing them are sometimes papillose, sometimes not, as is the case in *S. strictum*, the

<sup>10</sup> Sitz.-Ber. Naturhist. Ver. Preuss. Rheinl. u. Westf. 1932/33: 5. 1934.

<sup>11</sup> Sphagnologia Universalis 145.

<sup>12</sup> Leg. Bamberger 1858, in Herb. Wilms according to Warnstorf.

<sup>13</sup> Op. cit. p. 5.

<sup>14</sup> Ann. Bryol. 12: 143. 1939.

stem-leaves tend to be somewhat larger; other characters seem to give no substantial distinctions. Besides the African continent, Warnstorf gave for *S. Pappeanum* the Canary Islands in the Atlantic and Bourbon and Réunion in the Indian Ocean. I have examined his specimens and see no reason to disagree with his determinations. This is, however, not the case with the locality on Amsterdam Island, which lies much farther remote in the Indian Ocean in the latitude of southern Australia and New Zealand and rather nearer to Australia than to the continent of Africa. The specimen thus included is the one described by Bescherelle<sup>15</sup> as *S. lacteolum* Besch. (1875), collected by G. de l'Isle. I examined the specimen in the Warnstorf herbarium and believe it to be referable rather to *S. antarcticum* Mitt., with which Bescherelle compared it in his original description. It is outwardly quite similar to the latter species and I did not find any characters, nor are there any in Bescherelle's description that are not consistent with that species. It constitutes, if my identification is confirmed, an interesting extension of range of the species otherwise confined to the Australian and New Zealand region, but one that might perhaps be expected in view of the nearly antarctic conditions of its habitat and the general character of the there associated flora. *S. antarcticum* is characterized by its very robust growth, by its broad, generally imbricate branch-leaves, showing in section their chlorophyll cells with central lumen but exposed narrowly on both surfaces, the walls of the empty cells where overlying them sometimes papillose, sometimes not, the stem-leaves much larger than in the other species and decidedly lingulate rather than triangular, generally spoken of as fimbriate in their apical part, really having a broad hyaline border region with somewhat irregular outer edge. In many of these respects the species stands closer to those of the subgenus *Inophloca*, with which it is easily confused.<sup>16</sup>

To sum up, I would conclude that the section *Malacosphagnum* contains in the whole world not 8, but 3 or at most 4 distinct species: the familiar *S. compactum* DC., *S. strictum* Sull., distinguished primarily by the position and character of the chlorophyll cells of the branch-leaves as shown in cross-section, *S. Pappeanum* C. M., possibly reducible to *S. strictum*, though I have not ventured to reduce

<sup>15</sup> Comptes rendus de l'Acad. d. Sciences 81: 725. 1875.

<sup>16</sup> After correctly recognizing in 1911 the extensive synonymy of *S. antarcticum*, Warnstorf in 1915 (*Hedwigia* 57: 78) unnecessarily described a further new species (*S. Weymouthii* Warnst. from Tasmania) which must be added to it.

it absolutely, and finally *S. antarcticum* Mitt., quite distinct by the characters mentioned above. *S. rigescens* Warnst. I have removed from *Malacosphagnum* altogether and *S. lacteolum* Besch. I have included in the synonymy of *S. antarcticum* rather than of *S. Pappeanum*.

ITHACA, N. Y.

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## SOME MOSSES NEW TO MOUNT DESERT ISLAND AND MAINE

IRMA SCHNOOBERGER AND FRANCES WYNNE

One day's botanizing on Mount Desert Island in July, 1940, resulted in the collection of numerous interesting bryophytes. The collecting, all of which was done in Acadia National Park, was made possible by the Ranger, Mr. John Pierce, a student at the University of Michigan, who acted as a guide and arranged for collecting permits.

Of the numerous habitats on the island, we visited five: 1) a mixed coniferous forest above Thunder Hole; 2) a small alpine bog at the summit of Mt. Cadillac, elevation 1530 ft.; 3) a secondary forest in Bear Brook Valley; 4) the rocks and banks of Jordan Pond Stream; and 5) the hardwoods on South Bubble Mountain. A discussion of the geology of the island may be found in Rand and Redfield's *Flora* (1894).

Our collections, totaling 65 species of bryophytes, include eight species new to the Island, two of which are new for the state of Maine. These were checked against lists by Paul W. Patterson (1930), and Rand and Redfield, the two most complete lists of the mosses reported for the Island. Because of its interesting position and flora, Mount Desert has been subject to considerable botanical work; in addition to the two articles cited above, there are several shorter papers dealing with the mosses of the Island: (Greenwood 1927, Kennedy 1899, Johnson 1926, and Taylor 1921).

If a few hours' rapid collecting results in such a variety of species, and such a proportionally high percentage of new records, it would seem that more extensive and careful work on the island would prove interesting and profitable.

A complete set of the specimens collected is in the Acadia Park Herbarium, as well as in our own herbaria.

The writers wish to express their appreciation to Dr. A. J. Grout for his checking of the identifications, and to Dr. W. C. Steere for his help with this report.

Two mosses as yet unreported from Maine in our collection are:

DICRANUM MUHLENBECKII Bry. Eur. On ground in dry woods, Bear Brook Valley.

LEPTODICTYUM TRICHOPODIUM (Schultz) Warnst. In old stream bed, Bear Brook Valley.

Among the additional mosses unreported from Mount Desert Island are:

BARBULA UNGUICULATA Hedw. On dry sandy ground, Bear Brook Valley.

GRIMMIA ALPESTRIS Nees. On granite rock in dry, light forest above Thunder Hole.

RHACOMITRIUM HETEROSTICHUM (Hedw.) Brid. var. SUDETICUM (Funk) Jones. Very common on rocks, Thunder Hole and Bear Brook Valley.

BRYUM ARGENTEUM Hedw. On dry soil, summit of Mt. Cadillac.

BRYUM CUSPIDATUM (Br. & Sch.) Schimp. On stone under bridge, Jordan Pond Stream.

BRACHYTHECIUM ACUTUM (Mitt.) Sull. Over logs and granite rocks in hardwoods, South Bubble.

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#### REVIEW

GROUT, A. J. North American Musci Perfecti Nos. 376-400; Newfane, Vt., July 1940.—North American Musci Perfecti continue in excellence and variety. Twelve collectors in eleven states have contributed to this issue. Six West Indian or Mexican species collected in the southern states are of special interest. All are rare and apparently do not fruit freely in their northernmost stations, but *Desmatodon Barbula* from Wakulla Springs, Florida and *Entosthodon*

*Drummondii* from Louisiana are, fortunately, well fruited. The others are sterile but have never been issued in a North American exsiccati before. They are *Brachymenium systylium*, from Louisiana (also known from Arizona and New Mexico); *Meteoriopsis patula*, *Pseudocryphaea flagellifera* and *Syrrophodon incompletus* from Dade Co., Florida.

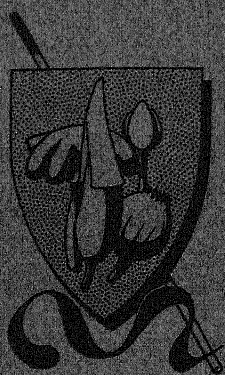
Very small species are nearly always interesting and welcome, and two of them make their appearance in this set. They are *Aphanorhegma patens* from Ontario, and *Nanomitrium synoicum* from Iowa. Other interesting species and varieties are *Pogonatum alpinum* var. *brevifolium*, *Oncophorus tenellus*, well fruited and with opercula, *Desmatodon latifolius* var. *muticus*, *Grimmia apocarpa* var. *gracilis* and *G. alpicola* var. *rivularis* f. *acutifolia* Grout n. f. The last form is described as new and is characterized by the prolongation of the leaves into a long narrow proboscis. The following correction in a former issue is made: No. 157 is *Grimmia alpicola* var. *rivularis* (Brid.) Broth., according to Jones.

The collectors include Walter Kiener, Colo.; Haring, Wickes & Grout, N. H.; Grout, Vt. & Fla.; Blomquist and Anderson, N. C.; E. A. Moxley, Ontario; H. S. Conrad, Ia.; Ruth Schornherst, Fla.; C. D. Adams, Me.; I. M. Haring, N. Y.; F. A. MacFadden, B. C.; and Faith Pennebaker, La. The complete issue is as follows:

376. *Pogonatum alpinum* var. *brevifolium* Brid., Colo.; 377. *Oncophorus tenellus* (Bry. Eur.) Williams, N. H.; 378. *Ceratodon purpureus* (Hedw.) Brid., N. H.; 379. *Desmatodon latifolius* var. *muticus* Brid., Colo.; 380. *Pogonatum capillare* (Rich.) Brid., N. H.; 381. *Sphagnum capillaceum* (Weiss.) Schrank, N. C.; 382. *Sphagnum tabulare* Sull., N. C.; 383. *Bartramia ithyphylla* Brid., Colo.; 384. *Plagiothecium Ruthi* Limpr., Colo.; 385. *Aphanorhegma patens* (Hedw.) Lindb., Ontario; 386. *Nanomitrium synoicum* (James) Lindb., Ia.; 387. *Grimmia alpicola* var. *latifolia* forma *acutifolia* Grout, Colo.; 388. *Desmatodon Barbula* (Schwaegr.) Grout, Fla.; 389. *Meteoriopsis patula* (Hedw.) Broth., Fla.; 390. *Pseudocryphaea flagellifera* (Brid.) E. G. Brit.; 391. *Dicranella cerviculata* (Hedw.) Schimp., Fla.; 392. *Syrrophodon incompletus* Schwaegr., Fla.; 393. *Brachymenium systylium* (C. Muell.) Jaeg., Fla.; 394. *Entosthodon Drummondii* Sull., La.; 395. *Haplohypnum triste* (Cesati) Kindb., Me.; 396. *Campylium hispidulum* (Brid.) Mitt., Me.; 397. *Polytrichum piliferum* var. *hyperboreum* (R. Br.) C. Muell., Me.; 398. *Pohlia elongata* Hedw., Vt.; 399. *Grimmia montana* Bry. Eur., B. C.; and 400. *Grimmia apocarpa* var. *gracilis* (Schleich.) Web. & Mohr, B. C.—SEVILLE FLOWERS, University of Utah, Salt Lake City, Utah.

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# THE BRYOLOGIST

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OCTOBER, 1941

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## TAXONOMIC NOTES. I. THE GENUS DACTYLHYMENIUM CARD.

A. LeROY ANDREWS

In 1909<sup>1</sup> Cardot, among several new genera of the Pottiaceae from Mexico, proposed the genus *Dactylhymenium* with the single species *D. Pringlei*, collected by Pringle near Chihuahua in 1885. The species had already been distinguished by Mrs. Britton with the unpublished name *Gyroweisia Pringlei*. Cardot's genus-name was meant to emphasize the principal generic character, namely a rudimentary peristome consisting of a narrow membrane without teeth. The genus, still monotypic, was then included by Brotherus in the second edition of Engler & Prantl.<sup>2</sup> The species has subsequently been found in several of our southwestern states and was distributed by Bartram from Arizona,<sup>3</sup> also from his specimens by Holzinger.<sup>4</sup> Cardot compared his new genus with *Anoetangium* and *Molendoa* because of its sometimes laterally borne sporophyte. In a discussion of the genus *Gyroweisia*,<sup>5</sup> with which Mrs. Britton had associated it, I asserted it to be closely related to the species commonly called *Didymodon tophaceus* (Brid.) Jur., a comparison which was subsequently repeated by Hilpert.<sup>6</sup> Renewed study has convinced me that it is indeed identical with that species and may then be reduced to synonymy under

<sup>1</sup> Rev. Bryol. 36: 72

<sup>2</sup> Natürliche Pflanzenfamilien 10: 276. 1924.

<sup>3</sup> Mosses S. Arizona 73, 112.

<sup>4</sup> Musc. Acro. Bor.-Amer. 632.

<sup>5</sup> THE BRYOLOGIST 25: 97ff. 1923.

<sup>6</sup> Bot. Centralbl., Beiheft L, 2: 645. 1933; also issued separately as a Jena Dissertation with the same pagination.

it. Hilpert speaks of the identity of leaf-form, areolation and leaf-section and perichaetial leaves, to which may be added all the other characters, so far as I can see, even the sometimes lateral position of the sporophyte, in that *D. tophaceus* also frequently shows subapical branching overtopping the originally terminal ♀-inflorescence which has given rise to the sporophyte. The peristome of *D. tophaceus*, which is very fragile and brittle, has teeth rising from a basal membrane. Though when fully developed they are divided as normally in *Didymodon*, they show great variation in different specimens as has been generally recognized by European bryologists, several of whom have referred to them as being sometimes quite rudimentary.<sup>7</sup> Mönkemeyer, in fact,<sup>8</sup> lists a variety *humilis* of Schimper characterized by this special feature (peristome-teeth rudimentary or lacking, "verkümmert bis fehlend"). As a matter of fact *Dactylhymenium* does not necessarily lack peristome-teeth. The specimens of Bartram show them in rudimentary form and even in Cardot's material<sup>9</sup> I found fairly long peristome-teeth by dissecting a capsule with operculum where they had not yet had a chance to break off. There being then no essential difference except reduction in size of the whole plant and its parts, apparently due to drier, less favorable climatic conditions, it is certainly in order to reduce *Dactylhymenium Pringlei* to *Didymodon tophaceus*, or whatever name one gives to the latter well known species.

It may be said that Austin had apparently noted the occasional lack of peristome-teeth of this species in our southwestern states, as his herbarium contains a specimen collected by Boll in Texas labeled and described as a new species (not new combination)<sup>10</sup> *Gymnostomum tophaceum*, which is not *G. rupestre* var. *stelligerum* as placed in Paris,<sup>11</sup> but precisely *Dactylhymenium Pringlei*. Williams' *Gyroweisia bolivi-ana*<sup>12</sup> from Bolivia must also be reduced to the same species, as it is obviously quite the same thing.

As to the specific name, *tophaceus* (Brid. 1819) was replaced by

<sup>7</sup> Schimper, Syn. 149. 1860; Ed. 2, 169. 1876; Boulay, Muscinées de la France 1: 449. 1884; Warnstorf, Kryptogamenflora der Mark Brandenburg 2: 229. 1904; Brotherus, Laubmoose Fennoskandias 129. 1923; Casares-Gil, Flora Iberica, Musgos 325. 1932.

<sup>8</sup> Laubmoose 295. 1927.

<sup>9</sup> Pringle, Plantae Mexicanae 4.

<sup>10</sup> Bull. Torr. Bot. Club 6: 42. 1875.

<sup>11</sup> Ind. Bryol., Ed. 2, 2: 297. The mistake of Paris rests in this case upon a mix-up of Lesq. & James.

<sup>12</sup> Bull. N. Y. Bot. Gard. 3: 117. 1903.

Lindberg<sup>13</sup> with the earlier but very dubious name *brevifolius* Dicks.,<sup>14</sup> now sometimes treated as a varietal name under *D. tophaceus*.

As to the generic name, *D. tophaceus* has been called many things according to different conceptions of generic grouping within the very puzzling family *Pottiaceae*. *Didymodon* itself is, as admitted by Steere, who treated the genus for Grout's Moss Flora of North America,<sup>15</sup> hardly a natural genus and, so far as typified by *D. rigidulus*, only very artificially separable from *Barbula*, as has been realized by many modern bryologists from Lindberg to Hilpert. Division of labor in Grout's work led to the treatment of *Didymodon* and *Dactylhymenium* by two different persons (Steere and Grout respectively) with the result that they are rather far separated, the former in *Pottiaceae-Trichostomeae* and the latter in *Pottiaceae-Pottiae*, where Grout has created the new combination<sup>16</sup> *Husnotiella Pringlei*. *Husnotiella* Card. in its original species (*revoluta*) had previously been reduced by Williams to *Didymodon*.<sup>17</sup> Hilpert<sup>18</sup> added the new combination *Barbula Pringlei*,<sup>19</sup> speaking also of its similarity to *Barbula tophacea*.

It is not my purpose at the moment to discuss further the natural place in the moss-system of *Didymodon tophaceus*. In its manner of growth it has some similarity, as Cardot noted for his *Dactylhymenium*, to the closely limited genera *Gymnostomum*, *Hymenostylium*, *Molendou*, *Anoctangium* and *Eucladium*, all of which have a similar habitat on moist or dripping rocks, which may account in some measure for such general similarity as they show. The real taxonomic relation of these genera both to one another and to other genera remains obscure down to the present day.

ITHACA, N. Y.

<sup>13</sup> Musc. Scand. 22. 1879 as *Barbula brevifolia*.

<sup>14</sup> Pl. Crypt. Fasc. II, 4. 1790.

<sup>15</sup> 1: 186. 1938.

<sup>16</sup> 1: 219. 1939.

<sup>17</sup> THE BRYOLOGIST 16: 25. 1913.

<sup>18</sup> Op. cit. 645. 1933.

<sup>19</sup> Not *B. Pringlei* Card. Rev. Bryol. 36: 85. 1909.

BARTRAMIA HEDWIG, NOMEN GENERICUM  
CONSERVANDUM PROPOSITUMELBERT L. LITTLE, JR.<sup>1</sup>

The well-known moss genus *Bartramia* Hedwig (1789, 1801), which contains about 10 species and which is the type of the family Bartramiaceae, is a later homonym of *Bartramia* Linnaeus (1753) and invalid under the International Rules of Botanical Nomenclature. The purpose of this article is to suggest that *Bartramia* Hedwig be included in the *nomina generica conservanda*, in order that this name may be correctly used hereafter. Otherwise, the name would have to be abandoned and a new generic name taken up. Adoption of a new generic name would require many new combinations and result in unnecessary confusion.

When the rule prohibiting use of all later homonyms was adopted by the International Botanical Congress in 1930, it was intended to make exceptions in the case of genera well established in usage, in order to avoid additional changes in names. These genera were to be added to the lists of *nomina generica conservanda* along with the later synonyms previously conserved.

Additional lists of later homonyms in the pteridophytes and spermatophytes have been proposed as *nomina conservanda*. The original list of *nomina generica conservanda proposita* for Musci in the International Rules (ed. 3, 129-130, 1935) contained later synonyms only. Apparently, no additional list of conserved genera of mosses has been published. When consulting Linnaeus, Species Plantarum, I observed accidentally that the name *Bartramia* had been used there for a genus of flowering plants in 1753.

It is proposed that the following generic name, a name invalidated by earlier homonyms, be included in the *nomina generica conservanda* of Musci at the next International Botanical Congress.

**Bartramia** Hedw. (Musci, Bartramiaceae), Descr. Musc. Frond. 2: 111, pl. 40 (1789), Sp. Musc. Frond. 164 (1801). Non *Bartramia* L., Sp. Pl. 389 (1753), et Gen. Pl., ed. 5, 184 (1754); non *Bartramia* Salisb., Prodr. 99 (1796). Type species: *B. Halleriana* Hedw.

*Bartramia* Hedw., a genus of about 110 species, is in universal usage by modern bryologists, including Brotherus (in Engler and

<sup>1</sup> Associate forest ecologist, Southwestern Forest and Range Experiment Station, which is maintained at Tucson, Arizona, by the Forest Service, United States Department of Agriculture.



Prantl, *Natürlichen Pflanzenfamilien*, Aufl. 2, 10: 451, 1924), Flowers (in Grout, *Moss Flora of North America* 2: 157, 1935), and Grout (*List of Mosses of North America North of Mexico*, *THE BRYOLOGIST* 43: 124, 1940). Numerous early references adopting this name are given by Pfeiffer (*Nomenclator Botanicus* 1: 371, 187). *Bartramia* Hedw. is the type genus of the family Bartramiaceae. Though several other genera have been segregated from *Bartramia* Hedw., apparently there are no later synonyms.

*Bartramia* L. (Tiliaceae) was reduced to a synonym of *Triumfetta* L., Sp. Pl. 444 (1753), Gen. Pl., ed. 5, 203 (1754), by Linnaeus himself (*Syst. Nat.*, ed. 10, 1044, 1759). This earlier homonym has not been used since 1804 apparently, and no recent authors have adopted it.

*Bartramia* Salisb. (Scrophulariaceae) is invalid both as a later homonym and as a later synonym of *Pentstemon* Mitch. ex Ait., Hort. Kew 3: 511 (1789). This homonym is not now used.

As *Bartramia* Hedw. is universally established in usage without confusion with the invalid earlier homonyms and apparently is without later synonyms, and as it is also the type genus of the family Bartramiaceae, the name *Bartramia* Hedw. is proposed for conservation. Until this name can be formally acted upon as a *nomen genericum conservandum propositum* at the next International Botanical Congress, it is hoped that bryologists will continue to use *Bartramia* Hedw.

It is not unexpected that the name *Bartramia* was applied to three genera by different authors. It commemorates John Bartram (1699–1777), the early American collector and botanist and the founder of the first botanical garden in the United States. Linnaeus established the genus *Bartramia* in 1747 (Fl. Zeyl., Nov. Gen. Pl. Zeyl. 9) without explaining its derivation. In his *Species Plantarum* (389, 1753), the starting point of botanical nomenclature, Linnaeus listed a single species, *Bartramia indica*, of India. The genus *Bartramia* was again formally described in 1754 (Gen. Pl., ed. 5, 184), with the observation that it was related to *Triumfetta*. In 1759 Linnaeus (*Syst. Nat.*, ed. 10, 1044) reduced *Bartramia* to a synonym of *Triumfetta* and gave to the same species the name *Triumfetta Bartramia*. In combining the two genera published in the same work, Linnaeus had the choice, under present rules, of the name to be retained. *Bartramia* was mentioned as a synonym also in 1762 (Sp. Pl., ed. 2, 638). However, by 1764 (Gen. Pl., ed. 6, 239) Linnaeus omitted the name entirely.



Recently *Bartramia indica* was included in the list of proposed standard species of Linnaean generic names in the International Rules of Botanical Nomenclature (ed. 3, 139, 1935).

Gaertner (Fruct. Sem. Pl. 2: 137, pl. 111, fig. 5, 1791) revived the genus *Bartramia* L. and named one species. De Candolle (Prodr. 1: 506, 1824) had *Bartramea* as a section of the genus *Triumfetta*. The genus *Triumfetta* [Plum.] L. (Tiliaceae) contains about 100 or more species of herbs and shrubs of warm and tropical regions of both hemispheres.

Hedwig gave the name *Bartramia* to a genus of mosses in 1789 (Descr. Musc. Frond. 2: 111, Pl. 40). The name appeared also in the German edition of the same work (Micro.-Anal. Laub-Moose 2: 126, pl. 40, 1789). Under the derivation Hedwig explained that he gave the name in memory of Bartram, the colonist in Pennsylvania who had sent specimens of many Linnaean species of cryptogams to Dillenius. Two species were described, *Bartramia Halleriana*, illustrated with a colored plate, and *Bartramia pomiformis*, a new combination based upon *Bryum pomiforme* L. (Sp. Pl. 1115, 1753). However, this four-volume work is not recognized in determining priority. Under the International Rules nomenclature of mosses begins in 1801 with Hedwig, Species Muscorum Frondosorum, in which *Bartramia* and both species were again described.

J. H. Barnhart<sup>2</sup> in 1914 suggested this nomenclatorial problem, apparently then under the American Code of Nomenclature, when he wrote:

"The Linnaean genus *Bartramia* was unquestionably named after John Bartram, although he thought it superfluous to say so. The same is true of the well-known genus *Bartramia* of Hedwig. Neither name is now tenable under modern rules of nomenclature."

The interest of John Bartram in mosses which led to the commemoration of his name for the genus of mosses was described also by Barnhart<sup>3</sup> as follows:

"With all available time occupied in the gathering of seeds and perennial flowering plants, Bartram paid very little attention to the flowerless ones. This was not due to any lack of interest, for he was a naturalist in the broadest sense of the word, but he lacked facilities

<sup>2</sup> Kelly, Howard A. Some American medical botanists commemorated in our botanical nomenclature, p. 53, footnote 2, 1914.

<sup>3</sup> Barnhart, John Hendley. Significance of John Bartram's work to botanical and horticultural knowledge. Bartonia No. 12, Supplement, pp. 31-32, 1931.

for their study, and they were poorly understood at that time even by specialists in the Old World. In the earlier part of his career, he was in correspondence with Dillenius, of Oxford, until the death of that botanist in 1747. To oblige Dillenius, he collected and transmitted to him at various times specimens of American mosses, and in gratitude the Oxford professor named for him a genus of mosses, *Bartramia*."

However, I have been unable to find the name *Bartramia* in Dillenius, *Historia Muscorum* (1768). In the most recent biography of John Bartram, Earnest<sup>4</sup> attributed the name *Bartramia* to Philip Miller (p. 74) and to Gronovius (p. 80) and mentioned also that Hedwig gave the name in 1789 to a genus of mosses.

*Bartramia* Hedw. is especially appropriate as a generic name of mosses for another reason. It honors also a direct descendant of John Bartram, Edwin B. Bartram, the contemporary American bryologist.

TUCSON, ARIZONA.

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## THE BRYOPHYTE FLORA OF ALSEA MOUNTAIN, BENTON COUNTY, OREGON

ETHEL I. SANBORN

In the Coast Range of Oregon are many small streams flowing at the bottoms of narrow, wooded ravines; streams which rise in the higher portions of the mountains. It was in such a ravine on the eastern slope of Alsea Mountain that the collections of the majority of the hepatics and many of the mosses were made. Collections of mosses and some hepatics were also made from locations in the nearby woods.

Alsea Mountain, with an elevation of 1332 feet, is one of the foothills of the Coast Range which extends eastward into the Willamette valley. The mountain is near the western boundary of Benton County, and is approximately fifteen miles from Corvallis which is located on the Willamette River, and about thirty-five miles from the Pacific Ocean.

The forests in this region, as is true for most of western Oregon, are largely coniferous, with a predominance of *Pseudotsuga taxifolia*,

<sup>4</sup> Earnest, Ernest. John and William Bartram, botanists and explorers. 187 pp., illus., 1940.

some *Tsuga heterophylla* and *Thuja plicata*. Intermingled with these are some deciduous trees, the most abundant of which are *Acer macrophyllum*, *Alnus oregana*, and *Fraxinus oregana*. Logging operations in the vicinity have deposited many logs in the ravine, some of which have to a greater or lesser extent blocked the stream, and have thus provided rotten wood in shady locations, an excellent habitat for many of the Hepaticae. As a result we have in the ravine varied ideal situations for the Bryophyta, muddy banks, sparsely grassed ledges, rotting logs, living trees, as well as the stream itself.

The list comprises twenty-six species of the Hepaticae, two of the Anthocerotae and twenty-three of the Musci. The collections were made on two trips to the region, one in late January, the other before the middle of February, 1940. Three graduate students, Clara J. Chapman, Maxwell S. Doty and Tsui-chieh Liu cooperated with the writer in this study.

## HEPATICAEE

### MARCHANTIACEAE

CONOCEPHALUM CONICUM (L.) Dumort. On wet banks and logs; frequent.

MARCHANTIA POLYMORPHA L. On wet banks; rare.

### RICCARDIACEAE

RICCARDIA LATIFRONS (Lindb.) Lindb. On rotten logs; rare.

RICCARDIA MULTIFIDA (L.) S. F. Gray. On rotten logs; common.

RICCARDIA MULTIFIDA var. AMBROSIODES (Nees) Lindb. On rotten wood; frequent.

### PELLIACEAE

FOSSOMBRONIA LONGISETA Austin. On moist banks; rare.

### LOPHOZIACEAE

NARDIA RUBRA (Gott.) Evans. On sandy, clayey banks in very moist situations; frequent.

NARDIA SCALARIS (Schrad.) S. F. Gray. On moist clayey banks; rare.

LOPHOZIA INCISA (Schrad.) Dumort. On low banks of a streamlet; rare.

CHILOSCYPHUS POLYANTHUS (L.) Corda. On rocks in and near edge of stream; rare.

### CEPHALOZIACEAE

CALYPOGEIA TRICHOMANIS (L.) Corda. On banks and grades; frequent.

CEPHALOZIA MEDIA Lindb. On logs and the ground; common.

CEPHALOZIA BICUSPIDATA (L.) Dumort. On rotting logs; common.

CEPHALOZIA LAMMERSIANA (Hüb.) Spruce. On rotting logs; common.  
LEPIDOZIA REPTANS (L.) Dumort. On rotting logs; frequent.

## PTILIDIACEAE

BLEPHAROSTOMA TRICHOPHYLLUM (L.) Dumort. On moist ground;  
rare.

## SCAPANIACEAE

SCAPANIA BOLANDERI Austin. On trees and logs; common.  
SCAPANIA UMBROSA (Schrad.) Dumort. On rotting wood; rare.  
SCAPANIA DENTATA var. AMBIGUA De Not. On rocks in running  
water; rare.

## RADULACEAE

RADULA COMPLANATA (L.) Dumort. On trunks of *Alnus oregana*;  
common.  
RADULA BOLANDERI Gott. On trunks of *Alnus oregana*; common.

## PORELLACEAE

PORELLA NAVICULARIS (L. & L.) Lindb. On trees and logs; common.  
PORELLA ROELLII Steph. On trees; frequent.

## LEJEUNACEAE

FRULLANIA BOLANDERI Austin. On trees; rare.  
FRULLANIA NISQUALLENSIS Sulliv. On trees; common.  
FRULLANIA FRANCISCANA Howe. On trees; common.

## ANTHOCEROTAE

## ANTHOCEROTACEAE

ANTHOCEROS FUSIFORMIS Austin. On stream banks; frequent.  
ANTHOCEROS LAEVIS L. forma AQUATICA W. Watson? On wood at  
water's edge; rare.

## MUSCI

## POLYTRICHACEAE

ATRICHUM UNDULATUM (Hedw.) Beauv. On moist soil along the  
streams; frequent.  
POLYTRICHUM JUNIPERINUM Hedw. On ground in open woods or on  
rotten wood; common.

## DICRANACEAE

DICRANUM SCOPARIUM Hedw. On soil, on rocks, bases of trees, de-  
caying wood; common.

## ORTHOTRICHACEAE

ORTHOTRICHUM SPECIOSUM Nees. On trees, occasionally on rocks;  
frequent.  
ORTHOTRICHUM CONSIMILE Mitt. On trees and logs; rare.

## AULACOMNIACEAE

AULACOMNIUM ANDROGYNUM Schwaegr. On rocks, soils or trees; common.

## BRYACEAE

BRYUM CAPILLARE Hedw. On soil and rotten logs, in woods; common.

## MNIACEAE

MNIUM MENZIESII (Hook.) C. Müll. On ground and bases of trees; common.

MNIUM PUNCTATUM Hedw. Moist soil along stream; frequent.

MNIUM VENUSTUM Mitt. Bases of trees; frequent.

MNIUM AFFINE Bland. Moist soil; common.

## HYPNACEAE

BESTIA BREWERIANA (Loesk.) Grout. On fallen logs along stream; frequent.

PSEUDISOTHECIUM STOLONIFERUM (Hook.) Grout. On soil, rocks, and trees in the woods; common.

EURHYNCHIUM OREGANUM (Sulliv.) Jaeger and Sauerb. On forest floor; common.

CAMPTOTHECIUM LUTESCENS (Huds.) Br. and Sch. var. OCCIDENTALE R. & C. On trees and logs; common.

LEPTODICTYUM RIPARIUM (Hedw.) Warnst. In water or on logs, in very damp situations; frequent.

RHYTIDIADELPHUS LOREUS (Hedw.) Warnst. On rotten wood; frequent.

RHYTIDIADELPHUS TRIQUETRUS (Hedw.) Warnst. On moist soil or on logs; common.

POROTHAMNIUM BIGELOVII (Sulliv.) Fleisch. On shaded trees, soil or rocks; frequent.

PLAGIOTHECIUM UNDULATUM Hedw. On moist soil and rocks; frequent.

HYPNUM SUBIMPONENS Lesq. On logs and trees in moist woods; common.

## NECKERACEAE

NECKERA DOUGLASHII Hook. Hanging on trees; common.

## CRYPTHAEACEAE

DENDROALSIA ABIETINA (Hook.) E. G. B. On trunks of trees, frequently associated with *Neckera Douglasii*; frequent.

DEPARTMENT OF BOTANY

OREGON STATE COLLEGE

CORVALLIS, OREGON

## MOSSES OF TOBAGO, BRITISH WEST INDIES

DOROTHY C. SALTO

Although the moss flora of Trinidad is reasonably well-known from the early collections of Krüger and the continued efforts of later botanists, only scattered references to the mosses of Tobago exist in the literature. Consequently it has been considered worthwhile to prepare the following list, in spite of the small number of species which it contains. The mosses mentioned below were collected by the author between July 12 and August 12, 1939, at the height of the rainy season. Most of the species are common in the hot tropical lowlands of the circum-Caribbean region, whereas others, as *Splachnobryum obtusum* and *Stereophyllum cultelliforme* represent interesting extensions southward of their range in the Antilles.

Mosses play a comparatively small part in the general vegetation of the island, especially near sea level. However, on the sides of the central mountain ridge which reaches a height of 1890 feet, in the thick moist forests they are in places luxuriant. Further collections in Tobago, particularly in the nearly impenetrable mountain forests, will undoubtedly reveal many more species.

The author wishes to express her deepest thanks to Dr. William C. Steere, who so kindly identified the collection with the exception of the Fissidentaceae, and to Dr. A. J. Grout, who identified the latter.

## FISSIDENTACEAE

**FISSIDENS KEGELIANUS** C. Müll. This was the most widely distributed species on the island, being found from one end to the other and ranging from sea level to 1000 ft. in altitude. It was present at the following collecting sites: at an alt. of 600 ft. between Merchiston estate and Speyside village in woods; at 500 ft. in dense wet bamboo forests on the NE promontory of the island between Black Rock and Anse Goulême; along the northern coast at sea level in open sandy land beneath coconut palms near Charlotteville; in dense forests up Pigeon Peak at 1000 ft.; at 400 ft. in woods on Mountain Hill; at sea level on the southern coast near Roxborough in open country; at 600 ft. on an open road cut near Green Hill; and at 300 ft. along the road at The Whim, midway across the western part of the island.

**FISSIDENS MOLLIS** Mitt. At 1000 ft. on Pigeon Peak in dense forest.

**FISSIDENS ANGUSTIFOLIUS** Sull. At 600 ft. in woods between Murchiston and Speyside; and on coral rock at sea level on the shores of Mt. Irvine Bay.



## LEUCOBRYACEAE

OCTOBLEPHARUM ALBIDUM Hedw. At 400 feet on Mt. Hill in woods.

## CALYMPERACEAE

CALYMPERES RICHARDI C. Müll. A widely distributed species. Found from sea level near Charlotteville on the north coast and sea level near Roxborough and Hope villages on the south shore, to 300 ft. along road cuts in Pembroke, at 400 ft. on Mt. Hill in woods, to 500 ft. in dense moist bamboo forests on the northeastern part of the island.

## POTTIACEAE

HYOPHILA TORTULA (Schwaegr.) Hampe. In open land 50 ft. above sea level on the west coast at Courland Point.

TORTULA AGRARIA Sw. On rock at sea level, Sandy Bay, extreme western point of the island.

## SPLACHNACEAE

SPLACHNOBRYUM OBTUSUM C. Müll. At 600 ft. in woods between Murchiston and Speyside.

## BRYACEAE

POHLIA CRUEGERI (Hampe) Andrews (*Bryum Cruegeri* Hampe). Along road cut at 250 ft. above Anse Bateau, northeastern part of the island.

## BARTRAMIACEAE

PHILONOTIS GLAUDESCENS (Hornsch.) Paris. At sea level near Charlotteville in sandy soil beneath coconut palms; at 100 ft. near Delaford along wood path; at 300 ft. along road cut in Pembroke.

PHILONOTIS GRACILIMA Angstr. Widely distributed. Sea level on extreme western end of island at Sandy Bay; 250 ft. along road cut above Anse Bateau in northeast; same situation at Pembroke on south shore; 300 ft. along road at The Whim; 500 ft. on rock of road cut near Green Hill.

## ORTHOTRICHACEAE

MACROMITRIUM MUCRONIFOLIUM (Hook. & Grev.) Schwaegr. At 1000 ft. in woods on Pigeon Peak.

## PLAGIOTHECIACEAE

STEREOPHYLLUM CULTELLIFORME (Sull.) Mitt. In dense woods at 400 ft. on northeastern end of island.

## SEMATOPHYLLACEAE

TAXITHELIUM PLANUM (Brid.) Mitt. At 500 ft. along road cut near Green Hill; 600 ft. in moist bamboo forest on northeastern end of island; and 1000 ft. in woods on Pigeon Peak.

CASILLA 122, LIMA, PERU

A SECOND LIST OF MOSSES FROM  
NORTHERN FLORIDA

RUTH OLIVE SCHORNHERST

Further study of collections made during 1937-40, and of additional material collected in 1941, has resulted in additional information on the moss flora of northern Florida described in a previous paper.<sup>1</sup> To the 139 species and varieties reported for the northern or continental part of the state the present list adds twenty-four species and varieties, ten of which are new records for Florida and two for the United States. Including a few species collected by other workers, the list now stands at about 170. All species reported in this paper were collected by the writer. Those species new to Florida are marked with an asterisk (\*). The classification and nomenclature of the Sphagnaceae follow A. L. Andrews, and the other groups, Grout's *Moss Flora of the United States North of Mexico*.

## SPHAGNACEAE

SPHAGNUM MACROPHYLLUM Bernh. This coastal plain species is easily overlooked because it so little resembles a moss. On wet banks of streams, immersed in some places. Liberty County, 1133; Taylor County, 1719.

SPHAGNUM PALUSTRE L. In juniper swamp, Liberty County, 1135.

SPHAGNUM PORTORICENSE Hampe. This species, common throughout the tropics, is confined to the coastal plain in the United States. Leon County, 1051.

## FISSIDENTACEAE

FISSIDENS ADIANTOIDES Hedw. var. SEMICRISTATUS Grout. On soil. Leon County, 82; Wakulla County, 1460 (determined by A. J. Grout).

\*FISSIDENS BUSHII Card. and Thér. On moist soil. Gadsden County, 36, 1571, 1580; Jefferson County, 998 (determined by A. J. Grout); Jackson County, 1502. This species has been reported previously from Thomasville, Georgia, only a few miles from the Jefferson County station.

\*FISSIDENS CRISTATUS Wils. var. WINONENSIS (Ren. and Card.) Grout. On limestone. Wakulla County, 1241 (determined by A. J. Grout).

\*FISSIDENS VIRIDULUS (Web. and Mohr) Wahlenb. On soil about the roots of trees. Gadsden County, 37 (determined by A. J. Grout), 1413; Liberty County, 1105; Leon County, 1599.

<sup>1</sup> Schornherst, Ruth Olive. A preliminary list of mosses from northern Florida. THE BRYOLOGIST 43: 57-73. 1940.

*FISSIDENS VIRIDULUS* (Web. and Mohr) Wahlenb. var. *TEXANUS* (Lesq.) Grout. On roots. Gadsden County, 35 (determined by A. J. Grout); Liberty County, 1009.

#### DITRICHACEAE

*BRUCHIA RAVENELII* Wils. On moist sandy soil near streams. Leon County, 1560, 1730.

#### DICRANACEAE

\**DICRANELLA SPHAEROCARPA* Card. On steep clay road bank. Leon County, 1547. This is the first report of this species from the United States. It is known otherwise only from Mexico and Puerto Rico.

*CAMPYLOPUS GRACILICAULIS* Mitt. var. *DONNELLII* (Austin) Grout (*Campylopus Donnellii* Lesq. and James). On sandy soil. Liberty County, 1002.

#### LEUCOBRYACEAE

*LEUCOBRYUM ANTILLARUM* Schimp. On soil in swamps. This tropical species has been collected only a few times in northern Florida. Gadsden County, 1574a; Leon County, 1616 (determined by W. C. Steere), 1669, 1670.

#### CALYMPERACEAE

*SYRRHOPODON INCOMPLETUS* Schwaegr. (*Syrrhopodon Hobsoni* Hook. and Grev.). On tree trunks. Rare. Leon County, 815 (determined by W. C. Steere); Levy County, 1703. These stations represent an extension northward of about three hundred miles for this tropical species.

#### POTTIACEAE

##### *Trichostomeae*

\**WEISIA JAMAICENSIS* (Mitt.) Grout (*Trichostomum jamaicense* (Mitt.) Jaeger). On limestone. Gadsden County, 35, 1527, 1617, 1637 (determined by E. B. Bartram). Although this West Indian species has been collected in Arizona, Oklahoma, and Texas, it is not reported for Florida.

\**GYMNOSTOMUM CALCAREUM* Nees and Hornsch. On limestone. Wakulla County, 1235a (determined by E. B. Bartram), 1695. The writer has been unable to find any published records of this species south of Tennessee and Virginia. A specimen collected by J. B. McFarlin in Citrus County, Florida, and determined by E. B. Bartram, is deposited in the herbarium of the University of Michigan. Further study of the Florida material will probably show it to be at least a new variety.

\**EUCLADIUM VERTICILLATUM* (Brid.) Bry. eur. On limestone along stream bank, continuously wet by splashing. Gadsden County, 1554 (determined by E. B. Bartram). L. E. Anderson has collected this species along the same creek. This is the first report for the coastal plain.

#### EPHEMERACEAE

\**EPHEMERUM CRASSINERVIUM* (Schwaegr.) C. Müll. var. *PAPILLOSUM* (Austin) Ren. and Card. On soil frequently flooded at high water. Gadsden County, 1541. This is apparently the first Florida collection.

#### BARTRAMIACEAE

*PHILONOTIS SPHAERICARPA* Brid. On bank of drainage ditch. Leon County, 1464; Levy County, 1700. This species has been reported a few times in peninsular Florida.

*PHILONOTIS UNCINATA* (Schwaegr.) Brid. On sandy soil. Liberty County, 1092. Like the preceding, this tropical species occurs in the southern part of the state.

#### BRYACEAE

*POHLIA CRUEGERI* (Hampe) Andrews. Leon County, 1557 (determined by A. L. Andrews). This is another tropical species occurring farther south in the state but not reported previously this far north.

#### MNIACEAE

\**MNIUM CUSPIDATUM* Hedw. On wet soil and limestone. Leon County, 30, 138; Alachua County, 1262; Jackson County, 1433 (determined by A. J. Grout); Gadsden County, 135. This is apparently the first report of this species for Florida.

#### HYPNACEAE

##### *Brachythecieae*

*HOMALOTHECIELLA SUBCAPILLATA* (Hedw.) Card. On bark of trees. Leon County, 93a; Gadsden County, 528.

##### *Plagiothecieae*

*PLAGIOTHECIUM MARIANNAE* Grout. On limestone, Marianna Caverns, Jackson County, 1442, 1495, 1505, 1663, 1729, 1730. The specimen bearing the collection number 1442 was collected at the same time as material from which Dr. Grout described this species.

\**TAXIPHYLLUM PLANISSIMUM* (Mitt.) Broth. On rotten wood. Liberty County, 1014 (determined by W. C. Steere). This is the first report of this tropical species for the United States.

FLORIDA STATE COLLEGE FOR WOMEN

TALLAHASSEE, FLORIDA

## BRYOLOGY IN THE OKEFENOKEE

A. J. Grout

For years I have been intrigued by the fascinating mysteries reported from the great Okefenokee Swamp in southern Georgia and extending into Florida. It is second only to the vast Florida Everglades in size and interest. However, I always lacked information as to ways and means of entering this wild region and also I did not want to go unaccompanied by fellow naturalists.

After reading Veeren Bell's *Swamp Water* in the Saturday Evening Post and Mr. Bell's account of himself and his experiences in "Keeping Posted," I wrote him, asking for information.

He suggested Lem Griffis' fishing camp near Fargo, Georgia, as a good place to go for guides and boats so necessary for any worthwhile exploration of the swamp.

I then persuaded Drs. H. L. Blomquist and Lewis E. Anderson of Duke University to accompany me on a week-end trip. On Friday, February 7th, we arrived at Fargo and were directed to take a dirt road twelve miles to the camp. Due to the hard rain that day the road did not look very attractive in spots and meeting another car would have been a problem, in many places. However, after considerable mud splashing I arrived at Griffis' Camp about 4:00 P.M. and the others later, after dark.

The camp had plenty of blankets and there was an abundance of fat pine wood for the fireplace in our cabin, so we slept in comfort, though the cracks were wide and it snowed a little Sunday morning, for the first time in years.

Saturday morning we drove seven miles farther into the wildlife refuge of the swamp to the boat landing on a small lake. The refuge began at the Griffis' camp and no one is allowed to enter without a permit, which Griffis is authorized to give for fishing and exploring. Firearms are absolutely barred.

Saturday we took a twenty-five mile trip into the heart of the swamp through a channel kept open by Mr. Griffis for his fishing parties. As the powerful out-board motor pushed us through the narrow channel at twenty miles per hour it gave us a bigger thrill than any Coney Island scenic railway. The majestic aisles of bearded cypress were most impressive. Numerous small lakes and shallow areas of open water were covered with lily pads and brightened by thousands of the bright yellow spikes of the golden club (*Orontium*).

Creeping up the sides of the cypress trees and penetrating into folds and crevices were numerous Georgia "air plants" (*Andromeda phillyreifolia* Hook.) in fragrant bloom. This is the only climbing plant in our range that belongs to the Heath Family. The dahoon holly (*Ilex Cassine* L.) with bright red berries, was common, also red maple in bloom. The yellow-flowered *Bidens mitis* (Mx.) Sherf. was frequent at the edges of pools and the cypress trees were decorated with their catkins.

We were rather disappointed in the quality and quantity of bryophytes. *Leucobryum albidum* and *Plagiothecium micans* were all over the ground. The best finds were *Syrrophodon ligulatus* Mont., previously known in the U. S. from southern Florida only, growing in crevices of cypress bark, and *Cololejeunea contractiloba* Evans, previously known only from its Sanford, Florida, type locality. (See THE BRYOLOGIST 41: 80.)

Following is the list of bryophytes collected:

#### MOSSES (Bryales)

- BRUCHIA DONNELLII Aust. Common on sandy soil, Billy's Island.  
 BRYUM CAPILLARE Hedw. Old wet stump.  
 CAMPYLOPUS GRACILICAULIS Mitt. Sandy soil, Billy's Island.  
 C. FRAGILIS (Dicks.) Bry. Eur. Sandy soil near entrance to swamp.  
 CLASMATODON PARVULUS (Hampe) Sull. Bark of trees, Billy's Island.  
 FUNARIA HYGROMETRICA Hedw. var. PATULA Bry. Eur. Sandy soil near entrance to swamp.  
 LEPTODON TRICHOMITRION (Hedw.) Mohr var. IMMERUS (Sull. & Lesq.) Lesq. & James. Bark of trees; frequent.  
 LEUCOBRYUM ALBIDUM (Brid.) Lindb.  
 L. GLAUCUM (Hedw.) Schimp. Infrequent.  
 PHYSCOMITRIUM TURBINATUM (Michx.) Brid. Sandy soil near entrance to swamp.  
 PLAGIOTHECIUM MICANS (Sw.) Paris.  
 POLYTRICHUM COMMUNE Hedw., forma. Sandy soil near entrance to swamp.  
 SCHWETSCHKEOPSIS DENTICULATA (Sull.) Broth.  
 SEMATOPHYLLUM ADNATUM (Michx.) E. G. Britton. Bark of trees, Billy's Island.  
 SYRRHOPODON FLORIDANUS Sull. A mere scrap.  
 SYRRHOPODON LIGULATUS Mont.  
 S. TEXANUS Sull. On decaying wood.  
 TETRAPLADON PENNSYLVANICUS (Brid.) Sayre. Cow dung near entrance to swamp.

#### SPHAGNA (Det. H. L. Blomquist)

- S. CUSPIDATUM var. SERRULATUM Schlieph. In and near water; apparently the most common *Sphagnum*.  
 S. HENRYENSE Warnst. Wet soil and bases of trees and logs at edge of water.  
 S. MACROPHYLLUM Bernh. Immersed; fairly common.  
 S. MAGELLANICUM Brid. Moist to wet soil.  
 S. PORTORICENSE Hampe. Wet peaty soil; largest colony I have ever seen.



- S. RECURVUM* Beauv. Moist soil; not common.  
*S. STRICTUM* Sull. Moist soil; quite common.

HEPATICS (Det. H. L. Blomquist)

- CEPHALOZIA CATENULATA* (Hueben.) Spruce. On soil and decaying wood.  
*CEPHALOZIA MEDIA* Lindb. Very common.  
*RICCIA DONNELLII* Aust. Sandy soil, Billy's Island. The type locality of this species is Jacksonville, Florida.  
*RICCARDIA LATIFRONS* Lindb. Common.  
*PALLAVICINIA LYELII* (Hook.) S. F. Gray. Very common on moist peaty soil.  
*COLOLEJEUNEA CONTRACTILOBA* Evans. Mixed with *Frullania squarrosa*. On bark of trees.  
*FRULLANIA KUNZII* Lehm. & Lindenb.  
*F. SQUARROSA* (R. Bl. & N.) Dumort. Fairly common.  
*LEUCOLEJEUNEA UNCULOBA* (Lindenb.) Evans. Fairly common.  
*MASTIGOLEJEUNEA AURICULATA* (H. & W.) Schiffn. Rare; in cracks of bark.  
*MICROLEJEUNEA BULLATA* (Tayl.) Evans.  
*PLAGIOCHILA LUDOVICIANA* Sull. Unusually high up the trees.

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MOSES OF THE GRAND CANYON NATIONAL PARK

INEZ M. HARING

The preparation of a checklist of the mosses of the Grand Canyon National Park was undertaken in late August and early September, 1940. Up to that time no work had been done on the mosses of the Park. Nearly three weeks were spent collecting in that area, covering the North Rim, the South Rim, Dripping Springs, Indian Gardens, and Rowe's Well.

Grand Canyon National Park is located in the western north-central part of Arizona. It includes within its boundaries 1009 square miles, with an east-west length of 56 miles and an average width of 18 miles. The Colorado river has cut its canyon through this area from southeast to northwest, forming a gorge one mile in depth. There are also many canyons cut by tributaries of the Colorado river. The North Rim includes the Kaibab Plateau while the South Rim includes the Coconino Plateau.

Due to its size and the great variation of altitude this area has a wide range of plant life. The range of altitude from 2,000 ft. at the bottom of the Canyon to 9,000 ft. in other areas included in the Park naturally gives rise to a wide range of temperature and moisture conditions, and the different rocks forming this area have produced a wide variety of soils. On the bottom of the Canyon the rainfall is estimated to be about 12 inches a year and the summer temperature

may reach 117° F. in the shade. In contrast to this, on the crest of the Kaibab Plateau there is an average of approximately 26 inches of precipitation, much of which is in the form of snow, with a winter minimum of 25° below zero.

Of the seven life zones of plants found between the Equator and the North Pole, four are fully represented in the Grand Canyon National Park—the Lower Sonoran, the Upper Sonoran, the Transition, and the Canadian. In addition to this a few plants indicative of the Hudsonian Life Zone are found at the extreme summit of the Kaibab Plateau within the Park boundaries. Following are the elevational limits of the life zones as well as can be defined:

Lower Sonoran Life Zone.....	Canyon bottom to 4,000 ft.
Upper Sonoran Life Zone.....	4,000 ft. to 7,000 ft.
Transition Life Zone.....	7,000 ft. to 8,200 ft.
Canadian Life Zone.....	8,200 ft. to summit of Kaibab Plateau
Hudsonian Life Zone.....	A few "indicator" species at the extreme summit of Kaibab Plateau.

In collecting, an effort was made to determine the distribution of the mosses throughout these Plant Zones. The most common genus found in the Park was *Grimmia*, which could be collected from the river to the summit on both Rims. So far, only four species of *Grimmia* have been determined but the number will be increased when all the material collected has been worked over. *Tortula ruralis* (Hedw.) Smith was found throughout the whole range of life zones represented in the Park. Most of the material was sterile, except in the Upper Sonoran Zone, although some fruiting material was found in all zones. At the head of Hermit Creek, at an altitude of 5,250 ft., *Tortula ruralis* was found fruiting in abundance, not only in one limited area, but wherever found at that altitude. This correlation of course may be a coincidence but still was an interesting fact. The best growth of this species was found at an altitude of 7,800 ft. where it often assumed a cushion form, rather than the patchy growth of lower altitudes. The habitat in general was under low shrubs and trees. Throughout its range and often associated with it was *Bryum argenteum* L. var. *lanatum* (P. B.) Bry. Eur. of which no fruit was found. Equally abundant and in all zones was *Bryum caespiticium* L., mostly sterile. These two *Brya* occur in all zones, in the open as well as under trees.

Following is a list of mosses found in the Grand Canyon National Park. The capital letters following each species designates the life zones in which it was found, as determined to date.

## NORTH RIM

## SOUTH RIM

## POLYTRICHACEAE

*Atrichum undulatum* (Hedw.) Beauv.

(T. L. Z.)

*Polytrichum juniperinum* Hedw.

(T. L. Z.)

## DITRICHACEAE

*Ceratodon purpureus* (Hedw.) Brid. *Ceratodon purpureus* (Hedw.) Brid.  
(T. L. Z.; U. S. L. Z.) (T. L. Z.)

*Ceratodon purpureus* (Hedw.) Brid.

var. *xanthopus* (Sull.) E. G. B.

(C. L. Z.)

## ENCALYPTACEAE

*Encalypta vulgaris* Hedw. var. *mutica* *Encalypta vulgaris* var. *mutica* Brid.  
Brid. (C. L. Z.; T. L. Z.) (T. L. Z.)

## POTTIACEAE

*Husnotiella Pringlei* (E. G. B.) Grout *Barbula unguiculata* Hedw.?  
(C. L. Z.) (L. S. L. Z.)

*Tortula mucronifolia* Schwaegr. *Didymodon tophaceus* (Brid.) Jur.  
(T. L. Z.) (L. S. L. Z.)

*Tortula ruralis* (Hedw.) Smith (All *Pterogoneuron ovatum* (Hedw.) Dix.  
zones.) (U. S. L. Z.)

*Weisia Andrewsii* Bart. (U. S. L. Z.) *Tortula mucronifolia* Schwaegr.  
(U. S. L. Z.)

*Tortula ruralis* (Hedw.) Smith (All  
zones.)

*Weisia Andrewsii* Bart. (L. S. L. Z.;  
U. S. L. Z.)

## GRIMMIACEAE

*Grimmia alpicola* Hedw. (C. L. Z.) *Grimmia calyptrata* Hook.  
*Grimmia calyptrata* Hook. (U. S. L. Z.)

(U. S. L. Z.) *Grimmia decipiens* (Schultz) Lindb.  
(L. S. L. Z.)

*Grimmia apocarpa* (L.) Hedw. var.  
*atrofusca* (Sch.) Husn. (C. L. Z.)

## ORTHOTRICHACEAE

*Orthotrichum alpestre* Hornsch.  
(U. S. L. Z.)

## TIMMIACEAE

*Timmia bavarica* Hessel. (T. L. Z.)

## BARTRAMIACEAE

*Philonotis fontana* (Hedw.) Brid.  
(T. L. Z.)

## BRYACEAE

- |   |   |
|---|---|
| <i>Bryum argenteum</i> L. var. <i>lanatum</i><br>(P. B.) Bry. Eur. (All zones.) | <i>Bryum argenteum</i> L. var. <i>lanatum</i><br>(P. B.) Bry. Eur. (All zones.) |
| <i>Bryum caespiticium</i> L. (All zones.)                                       | <i>Bryum caespiticium</i> L. (All zones.)                                       |
| <i>Bryum pallens</i> Sw. (T. L. Z.)   | <i>Bryum cirratum</i> H. & H. (U. S. L. Z.)                                     |
| <i>Bryum turbinatum</i> (Hedw.) Schw.?<br>(L. S. L. Z.)                         | <i>Bryum gemmiparum</i> DeNot<br>(U. S. L. Z.)                                  |

## HYPNACEAE

- |   |  |
|---|--|
| <i>Eurhynchium diversifolium</i> (Schleich)<br>Bry. Eur. (T. L. Z.) | <i>Brachythecium collinum</i> Bry. Eur.<br>(U. S. L. Z.)           |
| <i>Hypnum revolutum</i> (Mitt.) Lindb.<br>(T. L. Z.)                | <i>Eurhynchium strigosum</i> (Hoffm.)<br>Bry. Eur. ? (U. S. L. Z.) |

## LESKEACEAE

- |  |   |
|--|---|
| <i>Leskea tectorum</i> (A. Br.) Lindb. var.<br><i>flagellifera</i> Best (T. L. Z.) | <i>Leskea tectorum</i> (A. Br.) Lindb. var.<br><i>flagellifera</i> Best. (T. L. Z.) |
|  | <i>Thuidium abietinum</i> (Brid.) Bry. Eur.<br>(U. S. L. Z.)                        |

Due to the shortness of time for collecting the above list is far from complete. Another survey is planned for the summer of 1941 with the hope of materially increasing the number.

I wish to express my appreciation to Dr. A. J. Grout for his invaluable help in checking, correcting and determining the various species. Without his help the work would not have been undertaken. Acknowledgments are due also to Mr. E. B. Bartram, Dr. Le Roy Andrews and Dr. A. J. Sharp for their assistance in identification and to Mr. Edward McKee, Park Naturalist of the Grand Canyon National Park for permission to collect in the Park, for his help in determining the Life Zones and their corresponding altitudes for the various locations, and for permission to use the data concerning the Park which was taken largely from *Natural History Bulletin* No. 3, 1936.

## THE MOSSES OF HOT SPRINGS NATIONAL PARK AND VICINITY

FRANCIS J. SCULLY

Hot Springs National Park offers an abundant moss flora within easy reach of the interested collector. The mountainous character of the area affords many different habitats for the various species of mosses. In addition an abundant rainfall and a temperate climate provide suitable growing conditions.

The mosses of this region have received little attention, and the following list of 67 species is presented with the hope that it will

stimulate further interest and add many more to the list. The determinations of the various species have been checked by Dr. H. S. Conard and Dr. A. J. Grout, to whom I am indebted for their courteous assistance.

*AMBLYSTEGIUM VARIUM* (Hedw.) Lindb. On bark of pine trees in low ravines.

*ANOMODON ATTENUATUS* (Hedw.) Hüben. Rare at base of gum trees in low ravines.

*ANOMODON MINOR* (Beauv.) Lindb. Rare at base of oak trees.

*ANOMODON ROSTRATUS* (Hedw.) Schimp. Common at base of oak trees.

*ATRICHUM ANGUSTATUM* (Brid.) Bry. Eur. Common on ground in dry oak woods.

*BARBULA CONVOLUTA* Hedw. Occasional on ground in dry oak woods.

*BARTRAMIA POMIFORMIS* Hedw. Occasional on moist open slopes of North Mountain.

*BRACHYTHECIUM CAMPESTRE* Bry. Eur. Occasional in open grassy fields.

*BRACHYTHECIUM OXYCLADON* (Brid.) J. & S. Occasional on moist rocks.

*BRACHYTHECIUM SALEBROSUM* (Hoffm.) Bry. Eur. Common on moist rocks.

*BRYUM BIMUM* Schreb. (*B. pseudotriquetrum* (Hedw.) Schwaegr.). On moist rock walls of waterworks dam.

*CAMPYLUM CHRYSOPHYLLUM* var. *BREVIFOLIUM* (Ren. & Card.) Grout. Rare on ground in moist woods.

*CAMPYLUM HISPIDULUM* (Brid.) Mitt. Occasional on stony walls.

*CAMPYLOPUS INTROFLEXUS* Hedw. In small mats on open slopes of North Mountain.

*CERATODON PURPUREUS* (Hedw.) Brid. Occasional on rocks in low open ravines.

*CIRRIPHYLLUM BOSCHII* (Schwaegr.) Grout. On moist limestone ledges on Ouachita River.

*CLIMACIUM KINDBERGII* (Ren. & Card.) Grout. Common on dirt covered rocks on creek banks.

*DICRANELLA HETEROMALLA* (Hedw.) Schimp. Common on moist dirt covered rocks.

*DICRANELLA HETEROMALLA* var. *ORTHOCARPA* (Hedw.) Paris. Found with species.

*DICRANUM CONDENSATUM* Hedw. Common on moist ground in low woods.

*DICRANUM FULVUM* Hook. On rocks in low ravines.

*DICRANUM SCOPARIUM* Hedw. Common in mats on ground in low woods.

*DIPHYSCIUM FOLIOSUM* (Hedw.) Mohr. Common on dry ground at base of oak trees.

*DITRICHUM PALLIDUM* (Hedw.) Hampe. Common on ground in open pine woods.

*DRUMMONDIA PROREPENS* (Hedw.) Jennings. Common at base of hickory trees in dry woods.

*ENTODON SEDUCTRIX* (Hedw.) C. Müll. Common at base of oak trees in dry woods.

*ENTODON SEDUCTRIX* var. *MINOR* (Aust.) Grout. Rare on stone walls.

*EURHYNCHIUM HIANIS* (Hedw.) J. & S. Occasional on ground in moist shady woods.

*EURHYNCHIUM SERRULATUM* (Hedw.) Kindb. Common at base of oak trees in low woods.

*EURHYNCHIUM STRIGOSUM* (Hoffm.) Br. & Sch. Occasional on ground in low woods.

*FISSIDENS CRISTATUS* Wils. Occasional at base of gum trees in low woods.

*FISSIDENS VIRIDULUS* (Web. & Mohr) Wahlenb. Rare on ground in low woods.

*FONTINALIS DISTICHA* Hook. & Wils. On rocks in creeks.

*FONTINALIS MISSOURICA* Card. On rocks in creeks.

*FUNARIA HYGROMETRICA* var. *PATULA* Bry. Eur. On gravel banks of open oak woods.

*FUNARIA SERRATA* Brid. On open moist grassy slopes of North Mountain.

*GRIMMIA LAEVIGATA* (Brid.) Brid. Common in mats on rocks on North Mountain.

*HEDWIGIA CILIATA* Hedw. Common on dirt covered rocks in open woods.

*HYGROAMBLYSTEGIUM FLUVIATILE* (Hedw.) Loeske. Occasional on moist rocks.

*HYGROAMBLYSTEGIUM IRRIGUUM* (Wils.) Loeske. Occasional on moist rocks.

*HYPNUM CURVIFOLIUM* Hedw. Occasional on dirt covered rocks in low ravines.

*LEPTODON TRICHOMITRION* (Hedw.) Mohr. Rare on rocks in low woods.

*LESKEA GRACILESCENS* Hedw. Rare at base of trees in low woods.

*LEUCOBRYUM GLAUCUM* (Hedw.) Schimp. Common on ground in open woods.

*LEUCODON BRACHYPUS* Brid. Occasional on bark at base of oak trees in low woods.

*LEUCODON JULACEUS* (Hedw.) Sull. Common on logs and at base of trees in low woods.

*LEUCODON JULACEUS* var. *FLAGELLIFERUS* Grout. Occasional with type species.



*MNIUM AFFINE* Bland. Rare on stumps in low woods.

*MNIUM CUSPIDATUM* Hedw. Common on ground in low woods.

*ORTHOTRICHUM PUSILLUM* Mitt. Rare on bark of trees in low woods.

*PHILONOTIS MARCHICA* (Willd.) Brid. On moist rock wall of water-works dam.

*PHYSCOMITRIUM TURBINATUM* (Mx.) Brid. Rare on ground in low woods.

*PLAGIOTHECIUM MICANS* var. *FULVUM* (Hook. & Wils.) Paris. Rare on rocks in creeks.

*PLATYGIRIUM REPENS* var. *ASCENDENS* (Schwaegr.) Grout. On bark at base of pine trees on North Mountain.

*PLEURIDIUM ACUMINATUM* Lindb. Rare on ground in low woods.

*POLYTRICHUM COMMUNE* Hedw. Common on dry ground in oak woods.

*POLYTRICHUM OHIOENSE* Ren. & Card. Occasional on ground in low oak woods.

*SCIAROMIUM LESCURI* (Sull.) Broth. On rocks in creeks.

*SPHAGNUM CUSPIDATUM* Ehrh. Common in bogs.

*THELIA ASPRELLA* Sull. Common at base of oak trees.

*THELIA HIRTELLA* (Hedw.) Sull. Common at base of oak trees.

*THELIA LESCURI* Sull. On rocks in low woods.

*THUIDIUM DELICATULUM* (Hedw.) Mitt. Common on dirt covered rocks and decaying logs in low ravines.

*THUIDIUM MINUTULUM* (Hedw.) Bry. Eur. Occasional at base of oak trees in dry woods.

*THUIDIUM VIRGINIANUM* (Brid.) Lindb. Rare on grassy slopes.

*TORTELLA CAESPITOSA* (Schwaegr.) Limpr. Common at base of oak trees in low woods.

*WEISIA VIRIDULA* Hedw. Common on ground in pine woods.

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NOTE—Dr. Hjalmar Möller, well-known bryologist, died March 19, 1941. He had accumulated the largest and most important collection of bryophytes ever privately owned, I daresay, and probably one of the finest in existence, whether private or public. It contains around 286,500 numbers. To illustrate its extent, I mention that the extra-Scandinavian collection of mosses (excluding *Sphagna*) contains 14,740 species and varieties. It will, I suppose, be incorporated in the Riksmuseum moss collection, which, although already very rich, is exceeded in size by Möller's. Möller, who had collected in many countries, in every province of Sweden, and in the tropics (esp. Java), was a college teacher (Lektor), but for many years was free from service to enable him to dedicate himself to a conspectus of the Swedish moss flora (*Löfmossornas utbredning i Sverige*, parts 1-13, 1923-1936).—FRANS VERDOORN.

*Volume 44, Number 4, containing pages 77-104, was issued August 26, 1941.*

## CHECK LISTS OF NORTH AMERICAN BRYOPHYTES

Extra copies of the Special Check List Number of *THE BRYOLOGIST* (October, 1940), containing lists of the North American species of mosses, Sphagna, and Hepaticae, may be obtained at the much reduced price of ten cents each, in any quantity, from the Curator of the S. M. S. Moss Herbarium; Dr. LEWIS E. ANDERSON, Department of Botany, Duke University, Durham, N. C. Reprints of the check list of Hepaticae may be purchased in any quantity, for two cents each (plus postage), from the curator of the S. M. S. Hepatic Herbarium: Dr. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

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## THE HEPATIC EXCHANGE CLUB

Beginning January 1, 1939, this Club has been operated under the same rules as The Moss Exchange Club. Privileges are available only to members of the Sullivant Moss Society who have paid annual dues of 25c to Dr. A. J. SHARP, Department of Botany, University of Tennessee, Knoxville, Tennessee. Only fully determined specimens in packets with complete data will be accepted. It is suggested that there be at least five packets of each species with an extra which will be forwarded to the Curator of Hepatics for the Sullivant Moss Society Hepatic Herbarium. All material for determination should be sent to the Curator of Hepatics, Dr. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

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## THE MOSS EXCHANGE CLUB

As announced in *THE BRYOLOGIST* 33: 100, Sept.-Oct., 1936, there is now an exchange club for mosses. This exchange is available to members of the Sullivant Moss Society upon payment of annual dues of 25 cents to Mrs. IRENE M. HARTING, Woodland, Ulster Co., N. Y. Only fully identified specimens in packets with complete data on them should be sent in. It is suggested that there be five or more packets of each species.

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North of Mexico

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*Member all the year staff of the Biological Laboratory, Cold Spring Harbor,  
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## A KEY TO THE FISSIDENTACEAE OF NORTH AMERICA

A. J. GROUT

The Fissidentaceae are a very distinct and homogeneous family related to the Dicranaceae in peristome structure but unique in leaf characters. Mostly small plants; leaves distichous, *lying in a single plane, somewhat contorted when dry, apparently split along the basal portion of the upper edge and clasping the stem and the leaf next above*; leaf cells small, smooth, mamilllose or papillose, as a rule nearly isodiametric, rarely more than 1.5 : 1 (except near the base), mostly irregularly hexagonal; costa well developed, ending a little below the apex to shortly excurrent (lacking in *F. hyalinus*). Sporophyte lateral or terminal; seta several times longer than the perichaetial leaves (except in subgenus *Octodicerus*); peristome single, of 16 forked, highly-colored teeth resembling those of *Dicranum* (undivided in a few species).

The peculiar structure of the leaf has been explained in several ways but the following explanation is now generally accepted:\* The clasping portion of the leaf represents the original leaf while the rest of the leaf is made up of two lamellae, one dorsal the other terminal. This is strongly confirmed by the structure of the costa and the fact that the supposed lamella is wanting in the perigonal leaves and very much reduced or wanting in the earliest stem leaves. The two parts making up the sheathing base of the leaf are called the vaginant or sheathing laminae; the terminal lamella ventral to the costa is the apical lamina, and the dorsal lamella the dorsal lamina.

We have two genera, *Fissidens* and *Bryoxiphium*.

\* See: *Annals of Botany* 13: 103. 1899.



## KEY TO THE GENERA

- Dorsal lamina well developed, equal in width to the apical lamina above; peristome well developed.....*I. Fissidens*.  
 Dorsal lamina only slightly developed; peristome lacking.....*II. Bryoxiphium*.

*I. FISSIDENS* Hedw., Fund. 2: 91. 1782; Sp. Musc. 152. 1801.

*Skitophyllum* LaPyl. in Desv., Jour. de Bot. 1814: 133. 1814.

*Schistophyllum* Brid., Bryol. Univ. 2: 679. 1827.

Plants with the characters of the family, mostly under 2 cm. in height; stem with central strand; portion of leaf occupied by the vaginant laminae varying but mostly at least  $\frac{1}{2}$  the length of the leaf; basal leaf cells usually somewhat larger and more distinct. Capsules oblong to ovoid, erect and symmetric to cernuous and arcuate; peristome teeth mostly strongly incurved when moist, the divisions mostly rough, nodulose or spirally thickened and papillose; operculum conic-apiculate to long-rostrate; calyptra barely covering the operculum as a rule, smooth, usually entire or split on one side, rarely mitrate. Type species *F. exilis* Hedw.

## KEY TO SECTIONS OF FISSIDENS

1. Leaves without costa.....1. *Schistostegiopsis* (*F. hyalinus*).  
 Leaves with well-developed costa.....2.
2. Leaf lamina of more than one layer of cells, aquatic.....11. *Pachyffissidens*.  
 Leaf lamina of a single layer of cells.....3.
3. Aquatic, slender and floating like a *Fontinalis*.....12. *Octodicerias*.  
 Not aquatic but often in wet places.....4.
4. Leaves, at least the perichaetial, bordered by 2-several rows of narrow, elongate cells.....5.  
 Leaves mostly not bordered; if bordered, border cells not elongate but differing only in color or density.....8.
5. Only the vaginant laminae bordered.....5. *Semilimbatus*.  
 Leaves completely bordered except sometimes at apex\*.....6.
6. Leaves soft and flaccid as in the *Splachnaceae*, much shriveled in drying; cells large.....2. *Reticularia*.  
 Leaves firm, merely contorted in drying; cells small.....7.
7. Border of only one layer of very long cells, with few exceptions.....3. *Limbatus*.  
 Border of shorter denser cells often in more than one layer.....4. *Pycnothallia*.
8. Leaves with a border of incrassate or differently-colored cells.....10. *Marginatus*.  
 Leaves entirely unbordered.....9.
9. Leaves papillose or strongly mamilllose, crenulate by projecting cell angles.....7. *Crenularia*.  
 Leaves smooth, or merely mamilllose.....10.
10. Leaves mostly sharply serrulate\*\* at apex; setae lateral.....9. *Serridium*.  
 Leaves entire or crenulate; setae terminal.....11.
11. Plants small; cells clear, large for the genus, incrassate.....6. *Aloma*.  
 Plants large, densely foliate; leaf cells mostly small and obscure.....8. *Amblyothallia*.

\* Except *F. Brittonii*.

\*\* Except *F. polypodioides*.

§ 1. SCHISTOSTEGIOPSIS C. Müll., *Linnaea* 1875: 262. 1875.

Mostly minute, delicate plants; stem without central strand, and leaves without costa; leaf cells very loose; seta terminal. 1. *F. hyalinus*.

§ 2. RETICULARIA Broth.

Plants small to medium sized for the genus, gregarious to caespitose, growing on soil; leaves soft and flabby, elongate, acute, strongly bordered all around except occasionally at the apex (wholly unbordered in *F. Brittonii*), with long narrow stereid cells; entire or rarely slightly serrulate at apex; costa ending well below the apex (except in *F. palmatus*); leaf cells large, parenchymatous, thin-walled and much shrunken when dry, causing the leaves to twist and shrivel and making them slow and difficult to soak out. Seta terminal; operculum long-rostrate.

The texture of the leaves and their behavior when dried remind one of the leaves of Mniaceae or Funariaceae, but they are much smaller.

The slenderness of the leaf apex varies greatly in all the species included.

KEY TO SPECIES

1. Leaves crenulate, wholly unbordered.....1. *Brittonii*.  
Leaves bordered nearly or quite to apex.....2.
2. Costa percurrent or nearly so; capsules unsymmetric and horizontal (Forms of *F. mollis* have an almost percurrent costa).....4. *palmatus*.  
Costa ending well below the apex; capsules erect to horizontal...3.
3. Costa ending far below the apex, sometimes in the middle of the apical lamina; capsules horizontal and unsymmetric...5. *reticulosus*.  
Costa usually ending but a few cells below the apex; capsules erect or inclined, nearly or quite symmetric.....4.
4. Border distinct to the apex in most leaves; upper leaf cells up to  $40 \times 27 \mu$ .....3. *mollis*.  
Border vanishing at apex or apical marginal cells little differentiated; upper leaf cells up to  $13 \times 27 \mu$ .....2. *dissitifolius*.

§ 3. LIMBATUS (§ *Bryoidium* C. Müll., Gen. Musc. 56. 1901, emend.).

Mostly small, bright green, gregarious mosses growing chiefly on soil, occasionally on rocks; leaves soft, bordered all around except occasionally at the apex; border 1 cell thick of long linear cells; cells of the lamina mostly hexagonal, thin-walled, and not obscure, smooth except in *F. yucatanensis* which has a large central papilla on each side of the cell. Sporophyte terminal; peristome teeth with the forks mostly spirally thickened.

KEY TO SPECIES

1. Leaves long decurrent, even to the next leaf.....5. *longidecurrens*.  
Leaves slightly or not at all decurrent.....2.
2. Leaf cells with a single large central papilla.....11. *yucatanensis*.  
Leaf cells smooth.....3.

3. Leaf border confluent with the costa in most leaves\*.....2. *bryoides*.  
Leaf border ceasing below apex.....4.
4. Plants 1-5 cm. long, usually submerged (Pacific Coast).....7. *rufulus*.  
Plants rarely over 5 mm., not submerged except at high water.....5.
5. Capsules symmetric, erect to inclined.....6.  
Capsules more or less unsymmetric, inclined to horizontal.....11.
6. Border of vaginant laminae edged with small short cells below.....7.  
Border of vaginant laminae not so edged.....8.
7. Costa reaching apex; capsules mostly inclined and unsymmetric.....4. *limbatus*.  
Costa ending several cells below the apex; capsules mostly erect.....8. *sublimbatus*.
8. Synoicous; leaf cells about 8  $\mu$  in diameter, those of the vaginant laminae little or not at all enlarged.....9. *tortilis*.  
Dioicous; most leaf cells larger than 8  $\mu$ .....9.
9. Plants 5-25 mm. high.....10. *viridulus*.  
Plants rarely 3 mm. high.....10.
10. Leaf cells of the vaginant laminae reaching twice the dimensions of the dorsal and ventral.....12.  
Leaf cells of vaginant laminae only occasionally noticeably larger than those of the dorsal and ventral.....6. *minutulus*.
11. Leaves mostly oblong-lanceolate, more or less apiculate; border nearly reaching the apex.....10a. var. *tamarindifolius*.  
Leaves oblong-lanceolate; border ceasing some distance below the apex; plants of the Gulf States.....10b. var. *texanus*.
12. Leaves oblong-lanceolate.....3. *Kegelianus*.  
Leaves linear-lanceolate.....1. *angustifolius*.

#### § 4. PYCNOTHALLIA C. Müll., Gen. Mus. Frond. 1901.

Plants with leaves bordered nearly or quite to apex with a strong cartilaginous border, usually of shorter cells than in the *Limbati*; leaf cells very small, obscure, papillose (except *Steyermarkei*); seta terminal; forks of peristome teeth spirally thickened.

##### KEY TO SPECIES

1. Leaf border not reaching apex, often forked.....3. *Weiri*.  
Leaf border complete, reaching apex and fusing with excurrent or percurrent costa.....2.
2. Leaf cells papillose, not incrassate; setae multiple, 3 mm.....1. *pleurisetus*.  
Leaf cells smooth, incrassate; setae single,  $\pm$  6 mm.....2. *Steyermarkei*.

#### § 5. SEMILIMBATUS Grout, Moss Fl. N. Am. 1: 8. 1936. (§ *Semilimbidium* C. Müll. emend.)

Small to medium-sized plants; leaves bordered on the vaginant laminae only, often on perichaetial leaves only, smooth or papillose, entire or crenulate on the margin; sporophyte terminal; peristome teeth forked (except *F. muriculatus*).

##### KEY TO SPECIES

1. Leaves smooth or cells merely bulging; nearly entire.....2.  
Leaves papillose; mostly crenulate.....7.

\* See *F. tortilis*, *F. Kegelianus*, and *F. angustifolius*.

2. Costa plainly ending below leaf apex.....3.
- Costa nearly or quite percurrent.....4.
3. Northern; leaves obtuse.....11. *obtusifolius*.
- Subtropical; leaves acute.....12. *pseudocexilis*.
4. Border largely intramarginal.....1. *Andersoni*.
- Border marginal.....5.
5. Border on perichaetial leaves only; peristome teeth forked...6. *exiguus*.
- Border on all upper leaves; peristome teeth not forked.....6.
6. Subtropical; peristome teeth not divided.....10. *Neoni*.
- Arctic; sporophyte unknown.....2. *arcticus*.
7. Border intramarginal.....8.
- Border marginal.....10.
8. Leaves linear-lanceolate, gradually acute.....4. *densiretis*.
- Leaves oblong to oblong-lanceolate, more abruptly acute.....9.
9. Plants larger; leaves up to 15 or more pairs...4a. *densiretis* v. *latifolius*.
- Plants smaller; leaves up to 7 pairs.....3. *Brouardi*.
10. Border extending to apex of vaginant lamina or beyond...5. *elegans*.
- Border at basal portion of vaginant laminae only.....11.
11. Leaf cells pleuripapillate.....12.
- Leaf cells with only one large sharp papilla; only perichaetial  
leaves bordered.....9. *muriculatus*.
12. Costa ending below apex; only perichaetial leaves bordered...7. *Garberi*.
- Upper leaves also bordered.....13.
13. Leaves up to 20 pairs; upper marginal cells showing mostly  
but one marginal papilla.....8. *leptopodus*.
- Leaves up to 10 pairs; upper marginal cells showing mostly  
two marginal papillae.....13. *Ravenelii*.

#### § 6. *ALOMA* C. Müll.

Small gregarious mosses growing on soil; leaves soft, not bordered, often more or less crenulate on the margins by projecting cell angles; leaf cells smooth, mostly hexagonal, translucent, usually more or less incrassate but not collenchymatous.

#### KEY TO SPECIES

1. Vaginant laminae 0.75-0.90 length of leaf.....3. *imbricatus*.
- Vaginant laminae rarely over  $\frac{2}{3}$  length of leaf, often less.....2.
2. Plants minute, almost stemless; gametophyte about 0.5 mm.  
high.....1. *closteri*.
- Stem well developed; gametophyte 1-10 mm. high.....3.
3. Leaf cells thin-walled, much longer than broad.....4. *inaequalis*.
- Leaf cells incrassate, nearly or quite isodiametric.....4.
4. Leaves linear-lanceolate; costa shortly excurrent in most leaves...5.
- Leaves oblong-lanceolate; costa ending below apex, rarely  
percurrent.....6.
5. Leaves nearly entire, very long and slenderly acuminate...7. *validicostatus*.
- Leaves crenulate, shortly acuminate.....2. *flexinervis*.
6. Costa ending 8-10 cells below apex.....5. *parvperculus*.
- Costa ending 2-3 cells below apex, occasionally percurrent...6. *pellucidus*.

#### § 7. *CRENULARIA* C. Müll., Gen. Musc. 62. 1901.

Small, slender plants; leaves not bordered, crenulate by protruding cell angles or papillae; leaf cells small, sometimes only 5  $\mu$  in diameter, mostly irregularly hexagonal and more or less rounded, papillose or strongly mamilllose, usually with a large central papilla, rich in

chlorophyll; seta terminal in all our species; peristome teeth spirally thickened, basal lamellae sometimes cristate. In several species 1-3 elongated marginal cells may occasionally be found on the vaginant laminae of the perichaetial leaves, but these are difficult of observation.

## KEY TO SPECIES

1. Dorsal lamina very narrow and gradually narrowed to a vanishing point above the leaf base ..... 4. *stenopteryx*.  
Dorsal lamina wider, reaching stem or ending abruptly ..... 2.
2. Papillae of leaf cells compound or multiple ..... 3. *pusillissimus*.  
Papillae simple ..... 3.
3. Costa percurrent or ending only 2-3 cells below apex at most ..... 4.  
Costa clearly ending several cells below apex; papillae single ..... 6.
4. Leaf cells only strongly mamillate ..... 1. *cylindraceus*.  
Leaf cells with a large sharp papilla ..... 5.
5. Leaves linear to narrowly linear-lanceolate, narrowly acute ..... 7. *Vardei*.  
Leaves broader, linear-oblong, obtuse to acute ..... 2. *Donnellii*.
6. Leaf cells bulging-papillose, frequent in subtropical North America ..... 5. *radicans*.  
Leaf cells with large blunt papilla, only two collections known ..... 6. *Steerei*.

*F. diplodus* and its allies are very close to *F. Donnellii* in general appearance.

*F. Bernoullii* Schimp., by C. Müll. Bull. Herb. Boiss 5: 173. 1897, would best be forgotten. Specimens sent to the New York Bot. Gard. as the type were *F. angustifolius*. Mr. Dixon has examined the "type" in herb. Kew and it is the same thing.

## § 8. AMBLYOTHALLIA C. Müll., Gen. Musc. 63. 1901.

Plants of medium size, usually with rather long stems; leaves stiff, long and narrow, ligulate to lingulate, obtuse or acute, strongly curved to one side when dry, unbordered throughout, entire or serrulate at apex, sometimes crenulate above; leaf cells smooth, small, rounded, more or less obscure; sporophyte terminal; peristome usually papillose.

## KEY TO SPECIES

1. Leaves broadly obtuse ..... 2.  
Leaves sharply to broadly acute ..... 3.
2. Leaves oblong lingulate, never apiculate; vaginant laminae  $\frac{2}{3}$ - $\frac{3}{4}$  length of leaf ..... 2. *lingulatus*.  
Leaves ligulate-oblong ..... 1. *asplenoides*.
3. Leaves sharply acute ..... 3. *similiretis*.  
Many leaves obtusely acute ..... 3a. *similiretis* var. *guadalupensis*.

*F. guadalupensis* includes *F. laxobasis* Bizot & Thériot and probably *F. martinicae* Besch., Ann. Sci. Nat. 3: 191. 1876, as the differences given by Beschereille, l. c. between *F. martinicae* and *F. guadalupensis* seem insignificant, as do the differences between *F. lingulatus* C. Müll. and *F. gracilifrons* C. Müll.

## § 9. SERRIDIUM C. Müll.

Plants of large to medium size; leaves unbordered, in most species serrate, at least above; leaf cells smooth to mamilllose; seta mostly lateral (except *F. osmundioides*, *F. Littlei*, and *F. Hallii*).

## KEY TO SPECIES

1. Costa ending several cells below leaf apex; costa covered above with short mamilllose cells. . . . . 7. *subbasilaris*.  
Costa percurrent or nearly so; \* cells of costa all long and narrow . . . . . 2.
2. Leaves entire, rarely with slightly irregular apical margins 6. *polypodioides*.  
Leaf margins finely and evenly crenulate by projecting cell angles, or serrate at apex. . . . . 3.
3. Plants very large; leaves toothed at apex only . . . . . 4. *Oerstedianus*.  
Plants medium sized, crenulate on most of the margin . . . . . 4.
4. Sporophyte terminal. . . . . 5.  
Sporophyte lateral. . . . . 7.
5. Costa ending several cells below apex; peristome teeth forked 5. *osmundioides*.  
Costa nearly percurrent; to excurrent. . . . . 6.
6. Peristome teeth not divided. . . . . 3. *Littlei*.  
Peristome teeth forked. . . . . 2. *Hallii*.
7. Costa stout, typically shortly excurrent. . . . . 8. *tarifolius*.  
Costa slender, nearly or quite percurrent. . . . . 1. *Bushii*.

§ 10. MARGINATUS (§ *Serridium* C. Müll., in part).

Leaves serrulate to crenulate, especially at apex, bordered by cells of a different color or texture, but little if at all elongated; border cells sometimes of more than one layer.

## KEY TO SPECIES

1. Margin bistratose. . . . . 5. *incrassatolimbatus*.  
Margin of only one layer of cells. . . . . 2.
2. Marginal cells more incrassate and darker. . . . . 4.  
Marginal cells merely different in color, sometimes lighter. . . . . 3.
3. Leaf cells up to 15  $\mu$ . . . . . 1. *adiantoides*.  
Leaf cells 6-10  $\mu$ . . . . . 4. *cristatus*.
4. Costa percurrent to excurrent; leaves finely serrate and acutely apiculate at apex, finely, sharply and regularly crenulate-serrulate on vaginant laminae. . . . . 3. *Bourgaeanus*.  
Costa percurrent; leaves distantly and coarsely serrate above, border of vaginant laminae distantly and irregularly toothed. . . . . 2. *austroadiantoides*.

## § 11. PACHYFISSIDENS C. Müll., Syn. 1: 45. 1849.

Plants large, aquatic or subaquatic, stiff and rigid; stems without central strand; leaves bi-tri-stratose except at margins; costa merging into the thickened lamina, vanishing in or near the apex; leaf margins nearly or quite entire, not bordered (except in *F. rochenensis*). Sporophyte lateral, rarely produced; capsules without stomata; peristome well developed.

\* Except *F. osmundioides*



## KEY

1. Leaves bordered.....3. *rochensis*.
- Leaves not bordered.....2.
2. Leaves acute to obtuse; margin entire or erose.....2. *grandifrons*.
- Leaves acute; margins sharply crenulate-serrate to base of  
vaginant laminae.....1. *diversiretis*.

## § 12. OCTODICERAS Brid. (as a genus).

Plants slender, aquatic, long, soft, and floating; central strand lacking; seta shorter or little longer than the perichaetial leaves; stomata lacking.

## KEY

1. Plants rarely over 4 cm. long; seta longer than the capsule.....1. *Hallianus*.
- Plants 5-15 cm. long, habit of *Fontinalis*.....2.
2. Seta shorter than the capsule; peristome teeth truncate.....2. *Julianus*.
- Seta longer than capsule; peristome teeth forked and slender-  
pointed.....3. *manateensis*.

## II. BRYOXIPHIMUM Mitt. Jour. Linn. Soc. 12: 580. 1869.

*Eustichia* C. Muell. Syn. 1: 42. 1849 (in part).

Plants slender, bright to yellowish green, more or less gregarious and silky; stems simple, stiff, radiculose and bulblike at base, central strand present; leaves closely imbricated, distichous, keeled, smooth, with a very narrow dorsal lamina not reaching the base; costa vanishing at or near the apex except in the abruptly long subulate-acuminate perichaetial leaves. Dioicous; seta shorter than the perichaetial leaves; capsule globular to obovate, smooth, peristome and annulus lacking; operculum slightly convex and rostrate; calyptra smooth, covering about  $\frac{1}{3}$  of the urn, cucullate. Type species, *B. norvegicum*.

## THE GENUS FISSIDENS IN PUERTO RICO

A. J. GROUT

This paper is based largely on the collections of Dr. William C. Steere, made during 1939 and 1940. These collections, consisting of close to 200 numbers of *Fissidens*, have thrown much light on several species and considerably increased our knowledge of the distribution of our North American species.

As careful as Sullivant was, he contributed considerably to the great number of synonyms in the North American species.

Mrs. Britton had seen several of the types of West Indian and South American species of the genus, and left valuable notes and slides. Her conclusions have been checked as far as material is available and have been accepted for some species without confirmation.

Anyone studying *Fissidens*, particularly from tropical regions, must remember that often two or more species grow intermingled and that one student may find one species in a given collection number and another student find an entirely different species. In Steere's material, each specimen is usually ample enough to contain everything likely to be found in the whole number.

Section *Reticularia* Broth.

*FISSIDENS DISSITIFOLIUS* Sull., Proc. Am. Acad. 5: 274. 1861.  
Steere 5057, 6061, 6405.

*FISSIDENS MOLLIS* Mitt., Journ. Linn. Soc. 12: 600. 1869.  
(type seen).

*F. macrophyllus* Mitt., l. c. (in part).

*F. bryodictyon* Besch., Rev. Bryol. 18: 50. 1891 (cotype seen).

*Conomitrium bryodictyon* Besch., l. c.

*Fissidens flexifrons* Besch., l. c.

*Conomitrium flexifrons* Besch., l. c.

*F. macrophyllus* was proposed for forms with a percurrent costa, but rarely are all the leaves of a plant thus characterized. This form has often been confused with *F. palmatus* Sw., but that species, not yet reported from Puerto Rico, has a very different leaf border at the apex, more like *F. reticulosus* in this respect. Steere 4054, 4098, 4455, 4597, 4888, 4930, 5026, 5049, 5440, 6685, 6908, 6910, 6912, 7157, 7166.

*FISSIDENS RETICULOSUS* (C. Müll.) Schimp., in C. Müll., Syn. 2: 526. 1851.

*Conomitrium reticulosum* C. Müll., Syn. 2: 525. 1851.

*Fissidens sphagnifolius* Sull., Proc. Am. Acad. 5: 275. 1861.

*F. palmatus* Besch., Rev. Bryol. 18: 50. 1891. (*fide* E. G. Britton).

*Conomitrium palmatum* Besch., l. c.

*Fissidens Lindbergii* Mitt., Journ. Linn. Soc. 12: 602. (*fide* E. G. Britton).

*Conomitrium hookeriaceum* C. Müll., Bull. Herb. Boiss. 5: 173. 1897.

Steere 4480, 5307, 6774.

Section *Limbatus* Grout (§ *Bryoidium* C. Müll. emend.)

*FISSIDENS KEGELIANUS* C. Müll., Linnaea 21: 181. 1848.

*Fissidens pseudobryoides* Schlieph., Bot. Zeit. 13: 424. 1855.

*F. minutulus* Sull., Musci Cubens. Wright. no. 11 (not Musci Allegh. no. 183. 1846).

- F. clavipes* Sull., Proc. Am. Acad. 5: 275. 1861.  
*F. monandrus* Mitt., Journ. Linn. Soc. 12: 598. 1869.  
*F. trinitensis* Hampe in Jaeg., Adumb. 1: 123. 1874-75.  
*F. flexifrons* Besch., Rev. Bryol. 18: 50. 1891. (in part).  
*Conomitrium flexifrons* Besch., l. c. 51.  
*C. crassicolle* Besch., l. c. (fide E. G. Britton).

*F. longifolius* Brid., Sp. Musc. 1: 166. 1806. (*Skitophyllum longifolium* LaPyl., Journ. Bot. Desv. 1813: 40. 1814): Mr. Williams made drawings from material sent to the New York Botanical Garden as the type, and he identified two specimens of *F. Kegelianus* as probably *F. longifolius*. But Mrs. Britton stated in her notes that this specimen did not correspond with the original description. It is almost certain that this is either *F. Kegelianus* or one of the known members of the § *Reticularia*, and the name is better ignored as unverifiable.

Common in the West Indies, and extending from Florida to South America. Steere 4001, 4448, 4455, 4480, 4795, 5297, 5616, 6517, 6533, 6538, 6542, 6597, 6681, 6683, 6689, 6773.

FISSIDENS ANGUSTIFOLIUS Sull., Proc. Am. Acad. 5: 275. 1861.

This is evidently closely related to the preceding and probably one is a derivative of the other. It is perhaps better regarded as a subspecies or variety, as intergradations are numerous and it is often a puzzle as to which name a given plant should be referred. As its name implies, this form is characterized by very long, narrow leaves which may reach  $2\frac{1}{2}$  mm. *F. Lindigii* (Hampe) Paris var. *latifolius* P. de la Varde & Thér. (Mem. Soc. Cub. Hist. Nat. 13: 206. 1939) seems to be this species, according to the notes and description. Steere 5501, 5567, 5626, 5633, 5634, 5653, 5655, 5849, 6026, 6598, 6620, 7157.

FISSIDENS TORTILIS Hampe & C. Müll., Bot. Zeit. 22: 340. 1864.

*F. reclinatulus* C. Müll., Bull. Soc. Roy. Bot. Belg. 1: 153. 1892. (type seen).

*F. reclinatulus* var. *brevifolius* Card., Rev. Bryol. 36: 69. 1909.  
*F. Heribaudii* Broth. & Paris, Rev. Bryol. 40: 33. 1913 (specimens from Mexico: Arsène nos. 4604 & 4609, det. Thériot, are forms of *F. tortilis*).

*F. Arsenei* Broth. & Paris, Smithson. Misc. Coll. 78(2): 8. 1926.  
*F. Carionis* C. Müll., Bull. Herb. Boiss. 5: 171. 1897 (a specimen from Guatemala so-determined by Brotherus is definitely *F. tortilis*).

- F. fasciculato-bryoides* C. Müll., l. c. 172 (*vide* E. G. Britton).  
*F. minutulus* Sull., Musci Cubens. Wright. no. 12 (not Musci Allegh. no. 183. 1846).  
*F. aequalis* Salm., Ann. Bot. **13**: 120. 1899 (this is a form in which the costa and border are shorter than usual).

Some sterile forms are hard to distinguish from *F. viridulus*, such as the Arsène specimens named *F. reclinatulus* var. *brevifolius* Card. by Thériot, but in general the leaves are narrower and much more slenderly acute, the border more nearly reaching the apex. The capsules are much more distinctive; being small and delicate with a more or less pronounced neck and without the thickened cell walls found in *F. viridulus* and *F. bryoides*; they may be erect or inclined. The serrulate leaves shown in Grout, Moss Flora of North America, pl. 7D, are unusual and rare. Steere 7174, 5302.

FISSIDENS BRYOIDES Hedw., Sp. Musc. 153. 1801.

*F. synoicus* Sull., Mosses U. S. 103. 1856.

*F. inconstans* Schimp., Syn. (Ed. 2) 114. 1876.

Steere 6052, 6058, 5657. The last has bulging leaf cells, which apparently often occur in species having smooth leaves.

FISSIDENS LIMBATUS Sull., Pacific R. R. Rept. **4**: 185. 1856.  
Steere 5290.

#### Section *Pycnothallia* C. Müll.

FISSIDENS WEIRI Mitt., Journ. Linn. Soc. **12**: 602. 1869 (type seen).

*F. varians* Besch. MS., in Mitten Herbarium.

*F. Howelli* Bartram, Proc. Calif. Acad. Sci. 4 Ser. **21**: 78. 1933.

*F. Eckmani* Thér., Mem. Soc. Cub. Hist. Nat. **13**: 205. 1939,

One of the most variable species of the genus. In the same colony may be found plants with the leaves entirely bordered except near the apex, others with only the vaginant lamina bordered, others with vaginant lamina and a portion of the dorsal lamina bordered, and still other combinations. The border, where present, is strong and often toothed, and sending branches in among the cells of the lamina. The border apparently never extends to the base of the dorsal lamina, but ends in an inwardly directed prong some distance above the base. The marginal cells where the true border is lacking usually show two marginal papillae.

One of the plants in a slide prepared from Salmon's type of *F. Nicholsoni* (Journ. Bot. 13: 123. 1899) has a portion of the dorsal lamina bordered and appears to be a form of this species, as is probably also *F. Bizoti* Thér. (Mem. Soc. Cub. Hist. Nat. 13: 205), since the characters given to differentiate it are not of specific rank. Two other probable synonyms are *F. Acunae* P. de la Varde & Thér. (l. c. 206) and *F. Lefebvrei* Besch. (Rev. Bryol. 18: 50. 1891). Steere 4235, 6247, 6766, 6843, 6954; Pagán 363. Steere's 7224 contains some plants which are normal *F. Weiri* and others which have an intramarginal band of narrow cells much as in *F. densiretis*, but otherwise very different from that species.

Section *Semilimbatus* Grout (§ *Semilimbidium* C. Müll. emend.)

FISSIDENS EXIGUUS Sull., Mem. Am. Acad. n. s. 3: 60. 1846.

*F. viridulus* var. *Lylei* Wils., Bryol. Brit. 304. 1855.

*F. pusillus* var. *Lylei* Braithw., Brit. Moss Fl. 1: 68. 1885.

*F. incurvus* var. *exiguus* Aust., Musc. Appal. no. 103. 1870.

Steere 7225.

FISSIDENS RAVENELII Sull., Mem. Am. Acad. n. s. 4: 171. 1849.

Steere 5632. The costa is less excurrent than in the Florida specimens, in none of which does the border extend the full length of the vaginant lamina.

FISSIDENS LEPTOPODUS Card., Rev. Bryol. 37: 120. 1910.

Although Cardot placed this species in the § *Crenularia*, the margins of the vaginant laminae, in fertile plants at least, as seen in a portion of the type, are bordered at the base to about one-half their length with long, narrow cells as in *F. Ravenelii*. The costa is often not quite percurrent, or may run into the apical point. Steere 5690, 5896, 5011, 5434, 5659, 5831, 6801.

FISSIDENS DENSIRETIS Sull., Proc. Am. Acad. 5: 274. 1861.

*F. Dussi* Broth., in herb. N. Y. Bot. Gard. (probably not published).

The elongate submarginal cells are wholly inside a narrow band of one or two rows of cells differing but little from the other lamina cells. This band does not extend the full length of the vaginant lamina. Steere 4239, 5636, 5898, 6686, 7049.

FISSIDENS GARBERI Lesq. & James, Proc. Am. Acad. 14: 137. 1879.

Common in the West Indies. Steere 4514, 4864, 5303, 5656, 6258, 6392, 6782, 6998.

FISSIDENS DIPLODUS Mitt., Journ. Linn. Soc. 12: 589. 1869. (type seen).

*F. muriculatus* Spruce in Mitt., l. c. 593.

*F. corticola* Schimp., Ann. Sci. Nat. 3: 191. 1876.

Only the perichaetial leaves have a border, and there only on the basal part of the vaginant lamina. The very large, sharp, single papillae have led to confusion with *F. Donnellii*, when sterile, but the vaginant laminae are crenulate in this species, just as on the other parts of the leaf margin, while in *F. Donnellii* they are more coarsely toothed. Steere 4992, 5179, 4830, 5398, 5628, 5907, 6141, 6146, 6148, 6289, 6311, 6321, 6335, 6393, 6669, 6918.

FISSIDENS ELEGANS Brid., Sp. Musc. 1: 167. 1806.

*F. intermedius* C. Müll., Linnaea 21: 181. 1848.

*F. cuspidulatus* Sull., Proc. Am. Acad. 5: 274. 1861.

*F. acicularis* C. Müll., Bih. Sv. Vet. Akad. 21(3): 12. 1895.

*F. flavifrons* Besch., Rev. Bryol. 18: 54. 1891.

*F. hemiloma* Besch., l. c. 50.

*Conomitrium hemiloma* Besch., l. c. 52.

*Fissidens hemicraspedophyllus* Card., Rev. Bryol. 37: 120. 1910.

*F. Hancockiana* Steere, Hancock Pacific Exped. 3(1): 2. 1936.

*F. Willisiae* Bartram, THE BRYOLOGIST 42: 152. 1939.

*F. hemiloma* has the vaginant lamina only about one-half the length of the leaf, as do *F. intermedius* and *F. hemicraspedophyllus*. Type material of each of these has been seen. The leaves of *F. hemiloma* are narrower and the costa of *F. intermedius* is slightly excurrent. Steere 4872, 4955, 5151, 5292, 5424, 6024, 6038, 6050, 6615, 6625, 6660, 6696, 6735, 6825, 6947.

#### Section *Aloma* C. Müll.

FISSIDENS CLOSTERI Aust., Bull. Torrey Club 5: 21. 1874.

Steere 6354, 5502. The plants are a little larger than those from continental U. S., but otherwise little different. This is a rather remarkable extension of range.

FISSIDENS INAEQUALIS Mitt., Journ. Linn. Soc. 12: 589. 1869 (type seen).

*F. latiusculus* (C. Müll.) Paris, Index Suppl. 160. 1900 (fide E. G. Britton).



The leaf cells are more like those of the § *Reticularia* than the § *Aloma*, but there is no border and the general appearance is somewhat like *F. closteri*. Steere 6382, 6919.

- FISSIDENS PELLUCIDUS Hornsch., Linnæa **15**: 146. 1841.  
*F. suberenatus* Schimp. in C. Müll., Syn. **2**: 531. 1851.  
*F. rufulus* Sull., Proc. Am. Acad. **5**: 275. 1861.  
*F. Wrightii* Jaeg., Enum. Fissid. **12**. 1869 (*vide* Paris).  
*F. pyrenocystis* Card., Rev. Bryol. **37**: 121. 1910.

Steere 4054, 4818, 5150, 5165, 5300, 5347, 5748, 5775, 5801, 5832, 6014, 6407, 6153, 6292, 6306, 6369, 6467, 6922, 6993, 7202.

- FISSIDENS FLEXINERVIS Mitt., Journ. Linn. Soc. **12**: 588. 1869.  
*F. portoricensis* E. G. Britton, in Herb. N. Y. Bot. Gard.

Steere 4072, 4113, 4165, 4168, 6048, 4828, 4866, 4985, 4995, 5904, 6048, 6136, 6166, 6476.

- FISSIDENS VALIDICOSTATUS Sull., Linnæa **42**: 465. 1879.

In brook by roadside, Mt. Britton, Sierra de Luquillo, April, 1940, A. J. Grout.

*F. pellucidus*, as I understand it, has relatively short, oblong, obtuse, or obtusely acute leaves with nearly entire margins and the costa ending well below the apex. From this form there runs a whole series of intergrading forms to *F. validicostatus* which has much longer, narrowly acuminate leaves with the costa percurrent to excurrent and bordered by only one or two rows of cells near the apex.

*F. flexinervis* is a form intermediate between these two, its leaves acute with a strong, flexuous, excurrent costa and with strongly crenulate margins. Crenulate margins may occur in the other forms to a greater or less extent. In the numbers of Spruce's Brazilian collections distributed as this species there are some undoubted *F. pellucidus*. However, no. 493 fits the description and I have taken it as typical.

#### Section *Crenularia* C. Müll.

- FISSIDENS DONNELLII Aust., Bot. Gaz. **4**: 151. 1879.  
*F. tenerimus* C. Müll., Acta Soc. Fenn. **19**: 10. 1891.  
*F. crenatoserrulatus* Card., Rev. Bryol. **36**: 70. 1909.

Steere 5521, 5563, 5585, 5611, 5658, 6410, 6481, 6677.

FISSIDENS VARDEI Thér., Mem. Soc. Cub. Hist. Nat. 13: 208. 1939.

*F. jamaicensis* E. G. Britton, in herb. N. Y. Bot. Gard.

Closely allied to *F. Donnellii* but easily distinguished by the very narrow, linear-lanceolate leaves. Type from Pico Turquino, Cuba (Acuña 119). The type has not been seen, but the species is so strongly characterized that Thériot's figures and description are unmistakable. Steere 5559, 5678, 5681, 5848, 5839, 6203.

FISSIDENS CYLINDRACEUS Mitt., Journ. Linn. Soc. 12: 590. 1869.

Steere 4833, 5305, 5493, 5672.

FISSIDENS RADICANS Mont., Ann. Soc. Nat. Ser. 2. 14: 345. 1840.

*F. flavicans* Schimp., in Herb. Kew (*vide* Salmon, Ann. Bot. 13: 125. 1899).

*F. Smallii* E. G. Britton, in herb. N. Y. Bot. Gard.

*F. santaclarensis* Thér. (Mem. Soc. Cub. Hist. Nat. 13: 209. 1939) and its var. *obtusifolius* Bizot (l. c. 210) seem, from notes and descriptions to be only large forms of *F. radicans*. Plants from Yucatán identified by both Steere and myself as *F. radicans* are as large as the measurements given by Thériot as distinctions. Steere 4263, 4978, 5052, 5157, 5306, 5648, 5687, 5709, 6294, 6388, 6640.

FISSIDENS STENOPTERYX Besch., Rev. Bryol. 18: 54. 1891 (type seen).

Well characterized by the very narrow, tapering dorsal lamina. Steere 5304, 5273, 5278, 7020, 7025.

*Fissidens Bernoullii* Schimp. (Bull. Herb. Boiss. 5: 173. 1897) is best ignored. Specimens sent to the New York Botanical Garden as the type are *F. angustifolius*. From the description, it belongs in the § *Crenularia* where Brotherus puts it.

#### Section *Amblyothallia* C. Müll.

FISSIDENS ASPLENOIDES [Sw.] Hedw., Sp. Musc. 156. 1801.

*Hypnum asplenoides* Sw., Prodr. 140. 1788.

*Dicranum asplenoides* Sw., Fl. Ind. Occ. 3: 1770. 1806.

*Fissidens flabellatus* Hornsch., Fl. Brazil 1: 91. 1840 (*vide* Fleisch.).

*F. turbinatus* Tayl., Lond. Journ. Bot. 7: 190. 1848.

*F. linguaeifolius* C. Müll., in Ule, Bryoth. Brasil no. 120 (*vide* Fleisch.).

*F. ligulatus* Hook. f. & Wils., Fl. N. Zeal. 2: 63. 1855 (*vide* Fleisch.).

- F. barbaemontis* C. Müll., Bull. Soc. Roy. Bot. Belg. **31**(1): 152. 1892. (*fide* E. G. Britton).  
*F. costaricensis* Besch., Bull. Herb. Boiss. **2**: 390. 1894 (*fide* E. G. Britton).  
*F. nigricans* Schimp., Ann. Sci. Nat. Ser. 6. **3**: 192. 1876 (type seen).  
*F. obtusulus* C. Müll., Gen. Musc. Frond. 64. 1901 (*nomen nudum*) (*fide* Paris).

*F. nigricans* is only a stunted, dark-colored form of this species. Steere collected similar forms in Puerto Rico (5389, 6539). Steere 4090, 5326, 5389, 6031, 6035, 6066, 6115, 6559, 6589, 6797, 7035.

- FISSIDENS SIMILIRETIS Sull., Proc. Am. Acad. **5**: 274. 1861.  
*F. laxobasis* Bizot & Thér., Mem. Soc. Cub. Hist. Nat. **13**: 205. 1939 (type collection seen: Eckman 7123, Cuba).  
*F. guadalupensis* Besch., Rev. Bryol. **18**: 54. 1891 (specimen from Guadalupe, ex herb. Bescherelle, seen).  
*F. firminusculus* Besch., Rev. Bryol. **18**: 50. 1891 (the type duplicate differs from typical *F. similiretis* by having the leaves nearly entire, and the dorsal lamina somewhat truncate at the base).  
*F. Helleri* Ren. & Card., Mem. Soc. Roy. Bot. Belg. **41**: 49. 1902.

*F. similiretis* is nearer *F. asplenoides* than is generally realized. The difference seems to be largely in the more acute leaves, but there is a considerable difference in this respect in different specimens, and some approach *F. asplenoides* quite noticeably.

*F. petrophilus* Sull. is often compared with this species because of a similar leaf shape and size, but the leaf cells of *F. petrophilus* are larger and pellucid, typical of the § *Aloma*.

#### Section *Serridium* C. Müll.

- FISSIDENS POLYPODIOIDES [Sw.] Hedw., Sp. Musc. 154. 1801.

Steere 4077, 4276, 4377, 4709, 5000, 5162, 5404, 6011, 6098, 6176, 6251, 7184, 7253. Nos. 6011 and 7253 have the leaves slightly toothed near the apex.

#### Section *Pachyfissidens* C. Müll.

- FISSIDENS ROCHENSIS Broth. in Urban, Symb. Ant. **3**: 421. 1902.

The margined leaves make this species almost unmistakable. It clearly belongs to § *Pachyfissidens*. Mt. Morales, in stream and rocky slopes, March 15, 1906, E. G. Britton and Delia Marble 485.

## STUDIES ON AMERICAN HEPATICAE. II.

## A NEW SPECIES OF BAZZANIA FROM THE WEST INDIES

MARGARET FULFORD

BAZZANIA (§ BIDENTATAE) *platystipula* Fulford

Caulibus gracilibus, prostratis, viridiusculis vel brunneo-luteis; foliis imbricatis, ascendentibus, asymmetricis ovatis, 0.7–1.2 mm. longis, bidentatis; cellulis 24–32  $\mu$  diam.; trigoniis magnis, convexis; amphigastriis imbricatis, subquadratis, undulatis vel 4-lobatis; bracteis femineis parte terminale tertia trilacinatis; perianthio ore breviter ciliato.

Plants in depressed mats or scattered among other bryophytes, light green, becoming yellow-brown in the older portions; stems slender, often coarse-filiform, to 5 cm. long, with leaves to 2 mm. broad, prostrate; lateral branches diverging at a wide angle; flagelliform branches numerous, long; leaf insertion curved in the upper part; the leaves two-toothed, approximate to densely imbricated, ascendent, becoming strongly deflexed on drying, unsymmetrically ovate, 0.7 mm.–1.2 mm. long, 0.5 mm. broad at the base, narrowed to the obliquely truncate, bidentate apex; the teeth acute to acuminate, two to four cells high, two or three cells broad at the base, the sinus lunulate to acute; the leaf cells large, thin walled, their lumina angular-rounded, the trigones large, with convex sides, sometimes confluent, the cuticle faintly verruculose; cells of the apical portion and dorsal base 24  $\mu$ –32  $\mu$  in diameter, of the median portion larger, and of the base 46  $\mu$ –50  $\mu$  x 32  $\mu$ , not forming a vitta: underleaves approximate to imbricated, subquadrate in outline, broader than the stem, to 0.65 mm. long and broad, attached in a straight line, the lateral margins convex from a straight base, the apex undulate to deeply four-lobed: female branches solitary, the bracts of the intermediate series divided to one-third into usually three laciniae, the lateral margins ciliate and dentate; the innermost series similar, the lateral margins long-ciliate and serrate to dentate: the perianth mouth (immature) short ciliate.

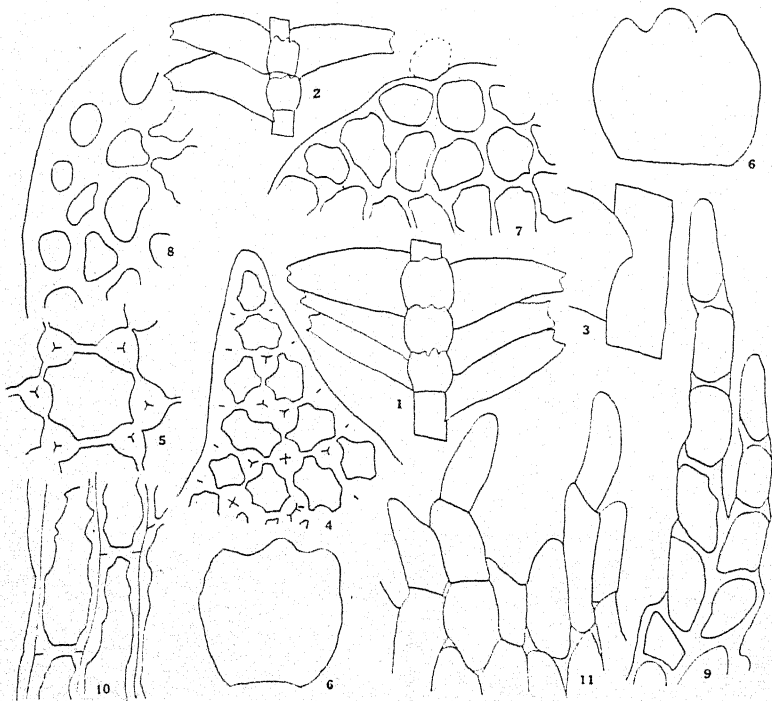
Habitat: On tree bases and logs, in mats or scattered among other bryophytes.

Distribution:<sup>1</sup> JAMAICA: John Crow Peak, 5500–5800 ft., Underwood 692 the type (Y, NY); Blue Mountain Peak, Patterson 23 (F). PUERTO RICO: Luquillo Mountains, Elizabeth Britton (NY).

The distinguishing characteristics of the species are its small size and greenish or yellow-brown color; the ascendent, shortly bidentate

<sup>1</sup> Specimens from the New York Botanical Garden are designated (NY); those from Yale University, including the private collection of Dr. A. W. Evans (Y); and those from the herbarium of the writer (F).

leaves with large, thin-walled cells and large, rounded trigones with convex sides; and the large, approximate to imbricated, subquadrate underleaves with entire, undulate to four-lobed apices. See Figures 1-11.



FIGS. 1-11. *B. PLATYSTIPULA* Fulford. Drawn from the type material. 1, 2. Portion of a plant, ventral view,  $\times 15$ . 3. Portion of a stem and leaf, dorsal view,  $\times 30$ . 4. A tooth of a leaf,  $\times 310$ . 5. A cell from the apical portion of a leaf,  $\times 400$ . 6. Underleaves,  $\times 30$ . 7. Portion of the apical margin of an underleaf,  $\times 310$ . 8. Portion of a transverse section of a stem,  $\times 310$ . 9. Cells from one of the laciniae of an innermost female bract,  $\times 310$ . 10. Cells from the lower portion of the same bract,  $\times 400$ . 11. Cells from the mouth of the perianth,  $\times 310$ .

The species is distinct from the other members of the § *Bidentatae* from the West Indies because of the large cells and the large trigones of the leaves, and the large, approximate to imbricated underleaves. *B. roraimensis* from British Guiana is similar in many ways, but its underleaves are very much smaller and are distant on the stem.

NECKERADELPHUS, A NEW GENUS  
IN THE NECKERACEAE<sup>1</sup>

WILLIAM CAMPBELL STEERE

**Neckeradelphus** gen. nov.

Plantae robustae dioeciae, habitu *Neckerae* similis; caulibus secundariis fere simplicibus vel pinnato-ramosis; ramis attenuatis vel flagelliformibus, valde complanate foliatis vel teretibus, turgidis; paraphylliis numerosis lanceolatis; foliis 8-stichis, undulatis, concavis, oblonge linguiformibus, apiculatis vel obtusis; costa conspicua, mediam vel tres partes folii altitudinem attingente; foliorum cellulis crassis, porosis; foliis perichaetialibus longe acuminatis; seta brevi; capsula immersa vel emergenti, oblonge ovoidea; peristomate longo, dentibus lanceolatis, nodosis, segmentis articulatis, fenestratis.

Plants robust, with the habit of *Neckera*; secondary stems 5-40 cm. long, to 5 mm. wide (including leaves), from nearly simple to regularly pinnately branched, complanate-foliate to nearly terete, turgid, bearing abundant, multiform, simple or branched paraphyllia; branches attenuate to flagellate, 1-10 cm. long; leaves oblong, linguulate, rounded at the apex, apiculate or obtuse, strongly undulate, concave, serrulate above; costa well developed, reaching one-half to three-quarters the length of the leaf; leaf cells thick walled, porose, linear to short rhomboidal, shorter toward the apex, the alar region hardly differentiated; dioicous, perichaetial leaves long lanceolate, gradually acuminate, not undulate. Seta very short; capsule immersed to emergent, oblong-ovoid to ovoid-cylindric; operculum oblique; peristome double, the teeth long, slender, nodose, obliquely striate-papillose at the base, segments long, linear, fenestrate between the articulations; spores rough; calyptra cucullate, without hairs. One species, the following:

**Neckeradelphus Menziesii** (Drummond) n. comb.

*Neckera Menziesii* Drummond, Musci Amer. No. 162. 1828.

*N. turgida* Juratzka, Verhandl. k.-k. zool.-bot. Ges. Wien 11: 414. 1861.

*N. Gennati* Rota in DeNot., Epil. Briol. Ital. 755. 1869 (*vide* Limpricht).

*N. mediterranea* Philib., Rev. Bryol. 7: 84. 1880.

*N. Menziesii* var. *limnobioides* Ren. & Card., Bot. Centralbl., 44: 422. 1890.

*N. Menziesii* var. *amblyclada* Kindb. in Macoun, Cat. Canad. Pl. 6: 162. 1892.

*N. jurassica* Amann in Limpr., Die Laubm. Deutschl., Oesterr. u. der Schweiz 2: 701. 1894.

*N. amblyclada* Kindb., Eur. & N.-Amer. Bryin. 17. 1896.

<sup>1</sup> Paper from the Department of Botany and the Herbarium of the University of Michigan.



*Eleuteria Menziesii* Stuntz, Bull. Torrey Bot. Club 27: 207. 1900.  
*E. Menziesii* var. *limnobioides* Stuntz, Bull. Torrey Bot. Club  
27: 208. 1900.

The generic segregation of the paraphyllium-bearing species of a large and complex group of mosses is by no means unprecedented, and numerous examples may be cited, particularly in the Rhytidiaceae and Hylocomiaceae (Brotherus, 1925). In addition to its possession of paraphyllia, *Neckeradelphus* differs from *Neckera* in several other clear-cut and important features. The well-developed costa, the dioicous inflorescence, and the extremely incrassate, porose walls of the leaf cells combine to form a complex of easily recognizable characteristics not found in the genus *Neckera* or elsewhere in the Neckeraceae.

The presence of paraphyllia separates *Neckeradelphus Menziesii* at once from all North American species of *Neckera*, since it is a condition easily seen with a hand-lens. In a consideration of the mosses of the world, however, it would be more difficult to segregate the species of *Neckeradelphus* on the basis of paraphyllia alone. Brotherus (1925), in the second edition of Engler und Prantl, *Die natürlichen Pflanzenfamilien*, lists *Neckera Menziesii* Hook., *N. turgida* Jur., *N. mediterranea* Philib. (group "Aa"), *N. macrocarpa* Broth. and *N. submacrocarpa* Dix. (group "Bb") in the section *Cryptopodia* as paraphyllium-bearing species. In the section *Euneckera* he lists (group "Aa") *N. obtusifolia* Tayl., *N. Spruceana* Mitt., *N. andina* Mitt., *N. eucarpa* Schimp., *N. amblyoglossa* C. Müll., and *N. laeviseta* Hook. f. & Wils. as species which possess paraphyllia. A survey of specimens or original descriptions of the species just listed shows that *N. macrocarpa*, *N. submacrocarpa*, *N. obtusifolia*, *N. Spruceana*, *N. andina*, *N. eucarpa*, *N. amblyoglossa*, and *N. laeviseta* are all autoicous species in which the costa is either very short or lacking completely. The last four species diverge still further from *Neckeradelphus* in the exerted capsules.

The only species of *Neckera* listed by Brotherus which certainly belong to *Neckeradelphus* are *N. Menziesii*, *N. turgida*, and *N. mediterranea*. Actually, *N. turgida* and *N. mediterranea* are only ecotypes of the polymorphic *N. Menziesii* and must be considered synonyms of it.

*Neckeradelphus Menziesii* was first discovered in northwest America between 1787 and 1793 by Menzies, and subsequently collected in the "Rocky Mountains" by Drummond, who distributed it as number

162 of his *Musci Americani*, in 1828. This seems to me to be the only interpretation possible from Drummond's label, which, after the description of "*Neckera Menziesii*, nov. sp.," gives the following information:

HAB.—Rocks among the Rocky Mountains, but without fruit.

OBS.—Mr. Menzies first discovered this very distinct species on the north-west coast of America, where it is not rare in fructification.

In spite of this clear statement, there has been considerable confusion in the literature concerning the original collector, the type locality, and the author of the species. Hooker is usually cited as authority for the name *Neckera Menziesii*, or even Hooker and Wilson, yet Drummond himself published it, as Hooker (1830) indicated later. From the original label of Drummond's number 162, no other conclusion is possible. Since Drummond based the species on his own collections, which were sterile, the type locality is the "Rocky Mountains," although Menzies did collect fertile material on the coast of Oregon much earlier. Nevertheless, Philibert (1880) says "Hooker a donné le nom de *Neckera Menziesii* à une mousse découverte par Drummond dans l'Amérique du Nord à l'état stérile"; Limpricht (1894) says "... in den Rocky Mountains (Nordamerika) zuerst steril von Drummond, später c. fruct. von Bolander in Californien entdeckt"; and even Grout (1934) says "Type locality, Rocky Mountains (Menzies)"; etc., etc.

Since its original discovery, *N. Menziesii* has been collected from California to Alaska and eastward through Idaho to Montana, and is especially abundant and well developed in the wet forests of Oregon, Washington, and British Columbia. Because it is so widely distributed and its variability rather well understood, few synonyms have been created for *N. Menziesii* in North America. Even Kindberg redescribed it only once, as *N. amblyclada*, a slight variant with less attenuate branches, concerning which Stuntz (1900), in his revision of the genus, says: "There is no material difference between the so-called variety *amblyclada* and the species, the leaves on the same plant varying in length and in length of costa. As to flagella, all the specimens seen have more or fewer flagella." Renauld and Cardot have proposed a single variety, var. *limnobiodes*, which intergrades completely with the species, and so has no taxonomic status. J. Baumgartner distributed California specimens labelled "*Neckera turgida*"

(No. 3096, *Kryptogamae exsiccatae editae a Mus. Hist. Nat. Vindobon.*), but was unable to establish it as a member of the North American flora, especially since the specimens were reasonably typical *N. Menziesii*.

The status of *N. Menziesii* in Europe has been much complicated by its disjunct geographical distribution, relative rarity, and much poorer development there. The first European material was collected by A. Röse in southern Germany, "im Dietharzer Grunde bei Tambach auf den Thüringer Walde." The specimens were at first called by C. Müller "*N. Roeseana*," but he seems not to have published the name, having recognized their identity with *N. Menziesii* and so published them (1853). In 1861, Juratzka described *N. turgida* from two of the Ionian Islands, Leucadia and Cephalonia, just west of Greece, with this remark: "*A. N. Menziesii* Hook. et Wils. paulo minori differt colore obscuriore, ramulorum indole, foliis profundius rugosis turgescens magis divergentibus latoribus, et obtusioribus." Schimper, in the first edition of his *Synopsis* (1860), accepted Müller's identification of Röse's specimens as *N. Menziesii* without question, but in the second edition (1876), he combined both Müller's and Juratzka's reports under *N. turgida*, with the comment: "*N. Menziesii* proxima et vix rite distinguenda, folia nec latoria nec obtusiora sunt, et sola reticulatione paulum angustiore, imbricatione densiore et turgida et colore foliorum juniorum saturatius viridi; ramuli minus longe flagelliformes evadunt." Although Juratzka himself (1882) later placed his *N. turgida* under *N. Menziesii*, after a discussion of the differences between the two species, with the explanation that "Allein die Abweichungen sind so geringfügiger Natur, dass die Trennung beider kaum gerechtfertigt werden kann," the name has persisted for several decades.

Fertile material of the European *N. Menziesii* was first discovered in southern France by Philibert (1880). He made a detailed study of this material and finally concluded that it represented a species distinct from both *N. Menziesii* and *N. turgida*, for which he proposed the name *Neckera mediterranea*. Unfortunately, although the characters by which he separated his new species from *N. Menziesii* are of some value, *N. mediterranea* and *N. turgida* are separated on such minor and subjective differences that the whole case for *N. mediterranea* is much weakened. Nevertheless, Limpricht (1894) recognized both *N. turgida* and *N. Menziesii* as distinct European species, ac-

cepted as valid *N. mediterranea*, and, furthermore, described a closely related manuscript species of Amann, *N. jurassica*. Limpricht's recognition of four excessively closely related "species" is an extreme position which later workers have not supported or followed. Husnot (1890) and Boulay (1894) considered both *N. mediterranea* and the European plant called *N. Menziesii* as *N. turgida*. This concept has continued to the present time with little modification. Amann (1912) holds his *N. jurassica* separate as a subspecies or "Race stationnelle xérophytique alpine du *N. turgida*, auquel elle est reliée par des formes transitoires." He also quotes the researches of Meylan (1902), who made a thorough comparative study of the four European "species," and found that *N. mediterranea* is synonymous with *N. turgida*, which is separated from the North American *N. Menziesii* by a series of rather quantitative characteristics, especially the shorter capsule and smaller exothecial cells. Curiously enough, Meylan rejected all the gametophytic differences proposed and recognized by earlier authors, and concluded that sterile specimens are generally impossible to separate. Mönkemeyer (1927), who is not particularly conservative in his treatment of many genera, makes no attempt to separate *N. Menziesii*, *N. turgida*, *N. mediterranea*, and *N. jurassica*, but lumps them under the oldest name, *N. Menziesii*, with the explanation that any differences are only in habit of growth and not in fundamental structure. I have examined European material of these four species and am completely in agreement with Mönkemeyer's conclusions. Culmann (1933) has followed Mönkemeyer in lumping these species, but for some unexplained reason, has selected the name *N. turgida* to represent them.

A critical comparison of American with European specimens of *N. Menziesii* reveals a series of minor differences which are actually tendencies rather than absolute differences. Since the American and European specimens differ in no greater degree than most other mosses common to the two continents, they are perhaps better considered as conspecific, especially since many completely intergrading forms exist. I was reminded very strongly of another series of somewhat intangible differences encountered several years ago in the comparison of European and North American specimens of *Gyrowisia tenuis* (Steere, 1939).

The habit of growth may appear to be very different, and even the best-developed European specimens never reach half the enormous size of American material from the Cascade Mountains, where the

stems may reach 40 cm. However, in exposed places, especially with reduced humidity, the American plants not only become dwarfed, but the characteristic pinnate, flagelliferous branches may be nearly or completely suppressed. American plants tend to be more clearly complanate-foliate, and more conspicuously undulate than European. These characteristics, again, are strongly influenced by humidity, and American specimens from exposed habitats have stems as turgid and as short as those of *N. jurassica*. It is possible to select specimens from northern California, for example, which almost exactly match the growth forms which in Europe have been called *N. turgida*, *N. mediterranea*, and *N. jurassica*.

In American plants, the capsule is nearly always immersed, and the peristome teeth tend to be shorter. Meylan has mentioned that the exothecial cells of American specimens are larger and the spores rougher, but I have been unable to confirm these features. The difference in the amount of ornamentation of the peristome teeth, stressed by Limpricht, is not trustworthy, as Meylan has noted. The teeth of some American specimens have conspicuous striate markings throughout, whereas in others the ornamentation is restricted to the basal part. The teeth appear to be embedded in a hyaline matrix which, although transparent, may sometimes be of the proper refractive index to conceal the delicate striations.

The variability of *N. Menziesii* is well shown by the type collection. In three separate sets of Drummond's *Musci Americani* which I have been able to examine, number 162 consists of two plants of very different appearance, which are not distinguished on the label or in any other way. One of them is regularly pinnate to bipinnate with conspicuously flagellate to filiform branches, while the other is irregularly pinnately branched, not particularly attenuate, and somewhat turgid. Drummond obviously appreciated the great variation of his new species under different ecological conditions, and so included the two contrasting growth forms, which under the microscope are identical. If Drummond's specimens had been more widely consulted, much nomenclatorial and taxonomic confusion could have been avoided.

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## TWO HEPATICS OF THE SIERRA NEVADA NEW FOR CALIFORNIA

In the summer of 1940, John Thomas Howell, Assistant Curator of Botany at the California Academy of Sciences, made a trip with the California Sierra Club into the Mount Brewer region and in the Kings River Cañon to collect flowering plants. The Hepaticae also engaged his attention and an exceedingly interesting collection was secured.

The most important discovery was *Pleuroclada albescens*, a genus which had not been found in California before. One of the specimens (Howell No. 510) came from Reflection Lake, Tulare Co., at 11,000-11,500 ft. elevation, while the second plant (Howell No. 515) was gathered at Ouzel Creek, Tulare Co., at 10,000 ft.

Another species new to California is *Leiocola Muellerei* (*Lophozia Muellerei*), from between East Lake and Reflection Lake in Tulare Co. (Howell No. 519, determined by Dr. Lois Clark). As far as the writer knows *L. Muellerei* is a species hitherto unknown in our Pacific States, though it has been collected in Canada.—DOROTHY SUTLIFFE, California Academy of Sciences, San Francisco, California.



## SOME HEPATICAE FROM NORTHEASTERN GEORGIA

DOROTHY PARKER

Between 1936 and 1938 the author collected several packets of Hepaticae in a few stations in northeastern Georgia. Since this area is so little known it seems advisable to publish a list of the species collected. The specimens were collected in Hall, Stephens, White, Lumpkin, and Habersham counties.

Most of the species reported here are well within their geographic range as stated in the literature, while a few represent slight extensions of ranges as indicated in the manuals.

In the list\* the distribution is given by counties and is followed by the packet number. The writer is indebted to Dr. Margaret Fulford for verifications and corrections. The specimens are deposited in my herbarium and duplicates are in the Hepatic Herbarium of the Sullivant Moss Society.

- CALYPOGEIA TRICHOMANIS (L.) Corda. Hall Co., 138.  
CEPHALOZIA CONNIVENS (Dicks.) Lindb. Hall Co., 215.  
ODONTOSCHISMA DENUDATUM (Mart.) Dumort. Hall Co., 158.  
PLECTOCOLEA CRENULATA (Smith) Evans. Hall Co., 215.  
PLAGIOCHILA ASPLENIODES (L.) Dumort. Stephens Co., 198, 199, 203, 204, 205, 206, 213, 214.  
DIPLOPHYLLUM APICULATUM (Evans) Steph. White Co., 237.  
SCAPANIA NEMOROSA (L.) Dumort. Hall Co., 171, 172, 173, 174; White Co., 238, 239.  
PORELLA PLATYPHYLLOIDEA (Schwein.) Lindb. Hall Co., 163.  
RADULA COMPLANATA (L.) Dumort. Hall Co., 170.  
FRULLANIA ASAGRAYANA Mont. Hall Co., 147; White Co., 227, 228, 230; Lumpkin Co., 148, 149.  
FRULLANIA EBORACENSIS Gottsche. Hall Co., 150, 216, 217, 218, 219, 220; White Co., 226.  
FRULLANIA SQUARROSA (R. Bl. & N.) Dumort. Hall Co., 152, 220.  
LEUCOLEJEUNEA CLYPEATA (Schwein.) Evans. Stephens Co., 197, 202, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214; Hall Co., 220; Habersham Co. (collected by Elizabeth Weatherly), 235.  
LEJEUNEA PATENS Lindb. White Co., 226, 228.  
PELLIA EPIPHYLLA (L.) Corda. Hall Co., 159, 160, 161.  
PELLIA NEESIANA (Gottsche) Limpr. Hall Co., 215.  
METZGERIA CONJUGATA Lindb. Stephens Co., 197, 198, 199, 203, 204, 206, 209, 211, 213, 214; White Co., 226, 228.  
METZGERIA FURCATA (L.) Dumort. Hall Co., 156.  
ASTERELLA TENELLA (L.) Beauv. White Co., 233.

\* The nomenclature follows that of the "List of Hepaticae found in the United States, Canada, and Arctic America" by Alexander W. Evans, THE BRYOLOGIST 43: 133-139. 1940.

NOTES ON THE WARNSTORF SPHAGNUM HERBARIUM  
III. THE SUBGENUS INOPHLOEA IN SOUTH AMERICA

A. LEROY ANDREWS

Warnstorf in 1911<sup>1</sup> listed and described from South America and adjacent islands 41 species of *Sphagnum* belonging to this group, only two of which are common to North America and Europe: *S. imbricatum* Hornsch. and *S. medium* Limpr. The former of these is not represented in the Warnstorf herbarium, had not been seen by Warnstorf and is credited to the island of Chiloe on the basis of a statement of Braithwaite. Though it is hard to see how Braithwaite could have been mistaken in identifying this very distinct species, its presence in southern South America needs confirmation. After careful study of Warnstorf's specimens I am convinced that the correspondence between South America and the northern hemisphere is, apart from the question of this one species, much closer than Warnstorf indicates.

To begin with our common species called by Warnstorf *S. cymbifolium* Ehrh. (1782), for which I had restored the older name *S. palustre* L. (1753). Warnstorf did not in 1911 admit this species from the southern hemisphere except from Australia and New Zealand, though in 1901 he had called it cosmopolitan. I find a number of his South American species inseparable by any essential character from this and without going into a detailed discussion of each one will merely list them as synonyms (12 in all) of this nearly cosmopolitan species (*S. palustre*):

*S. Puiggarii* C. M. (1887) from Brazil.

*S. Antillarum* Schimp. (1891) from Trinidad; not *S. Antillarum* Besch. 1876.

*S. brachycladum* C. M. (1897) from Brazil, according to Müller's type; specimens of Dusén assigned to it by Warnstorf appear to be rather *S. erythrocalyx*.

*S. heterophyllum* Warnst. (1899) from Brazil.

*S. suberythrocalyx* C. M. (1899) from Brazil.

*S. brachybolax* C. M. (1899) from Brazil.

*S. Kegelianum* C. M. (1900) from Dutch Guiana.

*S. Paranae* Warnst. (1905) from Brazil.

*S. santosense* Warnst. (1906) from Brazil.

*S. biforme* Warnst. (1911) from Brazil.

<sup>1</sup> *Sphagnologia Universalis* (Das Pflanzenreich, Hft. 51).

*S. orgaosense* Warnst. (1911) from Brazil.

*S. derrumbense* Warnst. (1911) from Ecuador. I find I have no notes on this species and Warnstorf did not figure it, but his description suggests *S. palustre*.

For the *S. medium* Limpr. (1881) of Warnstorf I had restored the name *S. magellanicum* Brid. (1798), which appears to be the oldest of many names given to this species. Warnstorf himself gives a considerable list of synonyms,<sup>2</sup> some of them unpublished herbarium names, a number of them South American. But a further number (8) of his independent species are reducible to this rather clearly recognized type:

*S. Weddellianum* Besch. (1891) from Peru and Brazil. Warnstorf's figure of this (80B) is wrong and does not correspond with his own description (p. 517).

*S. vesiculare* C. M. & Warnst. (1897) from Brazil. The description suggests rather *S. erythrocalyx*, but the only specimen in Warnstorf's herbarium and the one cited by him seems to be unquestionably *S. magellanicum*.

*S. longistolo* C. M. (1897) from Brazil.

*S. sanguinale* Warnst. (1898) from Brazil and British Guiana.

*S. rigescens* Warnst. (1898) from Tierra del Fuego. This species, included by Warnstorf in the wrong group *Malacosphagnum*, I have already discussed.<sup>3</sup>

*S. amoenum* Warnst. (1899) from Brazil.

*S. monzonense* Warnst. (1907) from Peru and Ecuador.

*S. Stewartii* Warnst. (1911) from the Galapagos Islands.

Of other species from the northern hemisphere *S. papillosum* Lindb. (1872) was not listed by Warnstorf from South America, though he did include it from New Zealand in the southern hemisphere. He does however include from South America species with papillae like those of *S. papillosum*, which I see no reason to separate from it and am accordingly reducing to synonymy with that species:

*S. brasiliense* Warnst. (1891) from Brazil. The plants tend to be somewhat smaller in all their parts, but differ in no other essential respect from normal *S. papillosum*.

*S. itacolumitis* C. M. & Warnst. (1897) from Brazil. The plants are not so well developed and papillae, though present, not so clearly made out.

<sup>2</sup> Sphagn. Univ. 487.

<sup>3</sup> THE BRYOLOGIST 44: 98. 1911.

*S. erythrocalyx* Hpe. (1848) represents a more difficult case. It is not a European species, but has its type locality and center of distribution in South America, extending however northward, as I understand it, through the West Indies and Central America and along the Gulf and Atlantic coastal region to New Jersey, where it is not uncommon, but no specimens clearly referable to it have as yet been found farther north. I have already discussed it at some length as a North American species,<sup>4</sup> including the reduction of a number of species described from there. It may sometimes be confused with *S. magellanicum*, sometimes with *S. palustre*, but its closest relationship is apparently with *S. papillosum* and if it were necessary to reduce it to synonymy, it could only be understood as *S. papillosum* without papillae. Its leaf-section shows chlorophyll cells with a more or less central lumen and curved contours exposed normally on both surfaces, though sometimes more strongly on the ventral surface, in the latter case suggesting *S. palustre* if the leaf is not actually sectioned. Apart from this feature it shows a minimum of fibrils in the cortical cells of stem and branches, very strong fibrils in the empty leaf-cells, pores not numerous on dorsal surface of branch-leaves, tending to be arranged in threes in adjacent corners of empty cells. The pigmentation is also rather distinctive: a light reddish brown, equally distinct from the more definite red of *S. magellanicum* and the brown of *S. palustre* and *S. papillosum*. I would further include in it from South America the following (13) species:

*S. erythrocalyx* Hpe. (1848) itself was in its type specimen collected by Beyrich near Rio Janeiro in 1822. I have seen the type material. Warnstorf said that his *S. Gehobii* 1902 was named from the same material later recognized as *S. erythrocalyx*.

*S. perichactiale* Hpe. (1848) from Brazil came from the same place and collector and was published on the following page of C. Müller's Synopsis, lacking then page priority as compared with *S. erythrocalyx*. Warnstorf did not apparently see the fragment of the type in Müller's herbarium, but depended upon a later specimen collected by Döring in Petropolis in 1859, which according to Warnstorf's description and figure is not the same thing, but clearly *S. magellanicum*, not fruiting. *S. perichactiale* was so named because fruiting and is quite the same as *S. erythrocalyx*.

<sup>4</sup> THE BRYOLOGIST 15: 64-66. 1912.

- S. peruvianum* Mitt. (1869) from Peru.  
*S. paucifibrosus* Warnst. (1891) from Brazil.  
*S. carneum* C. M. & Warnst. (1897) from Brazil.  
*S. ouropatense* C. M. & Warnst. (1897) from Brazil.  
*S. subbrachycladum* C. M. (1899) from Brazil.  
*S. macroporum* Warnst. (1905) from Brazil.  
*S. pauloense* Warnst. (1906) from Brazil.  
*S. Tijucae* Warnst. (1911) from Brazil and Bolivia.  
*S. Allionii* Warnst. (1911) from Ecuador.  
*S. glaucovirens* Warnst. (1911) from Brazil.  
*S. bahiense* Warnst. (1911) from Brazil, apart from its variety *Sincorae* Warnst., which will be discussed later.  
*S. discrepans* Warnst. (1911) from Brazil.

Of the 7 North American species of subgenus *Inophloea* 4 are then present in South America, or 5 if *S. imbricatum* really occurs there. *S. portoricense* Hpe. (1853), a derivative of *S. imbricatum*, is not now known to extend south of the West Indies nor *S. henryense* Warnst. (1900) south of our southern states on the Gulf of Mexico.

There remain 3 South American species which I am unable to reduce satisfactorily to any found in North America or elsewhere, which may then be regarded at least tentatively as endemic to South America. Perhaps the most interesting and distinct of these is the one named *S. alegrense* Warnst. (1907<sup>5</sup>) from Mt. Alegre in Brazil. This has a leaf-section like that of *S. magellanicum* with chlorophyll cells central and enclosed, but the inner walls of the empty cells where overlying the chlorophyll ones are not smooth as regularly in *S. magellanicum* nor papillose with rounded papillae, but covered with irregular roughening spoken of by Warnstorf as worm-shaped thickenings and well illustrated by him (fig. 84C), a condition similar to that in the North American *S. henryense*, which however has the leaf-section of *S. palustre* and also differs in other respects. Besides the 2 specimens (one of Glaziou, the other of Dusén) placed here by Warnstorf I am obliged to include another collected by Ule which was wrongly made by Warnstorf a variety ( $\alpha$  *Sincorae*, 1911) of his *S. bahiense* (= *S. erythrocalyx*, see above); it is very clearly the same thing as the *S. alegrense*.

*S. submedium* Warnst. (1906) from Brazil (leg. Mosén) has according to my own observations the leaf-section of *S. magellanicum*,

<sup>5</sup> Hedwigia 47: 83.

though Warnstorff figures and describes it as being rather of the type of *S. erythrocalyx*. The pores on dorsal surface of branch-leaves are the especially distinctive feature, being small and strongly ringed, sometimes close to, sometimes quite removed from the commissures. I note also the lack of membrane-gaps toward apex of leaf on dorsal surface as indicated by Warnstorff, but do not find a tendency to membrane-gaps farther down the leaf as he described them, but rather a continuation of the small corner-pores quite to the base of leaf. This species, based upon a single collection, may perhaps be regarded as doubtful until found in other localities.

*S. negrense* Mitt. (1869), collected by Spruce at several localities along the Río Negro, has the leaf-section of *S. palustre*, but again a distinctive system of pores on dorsal surface of branch-leaves. There are numerous small ringed pores along the commissures and very small ringed ones in middle portion of cells, especially in apical part of leaf. Warnstorff's figure (84F') illustrates this very clearly.

This leaves of Warnstorff's South American species of *Inophloea* from 40, 7 or if *S. imbricatum* is included, from 41, 8 which have some justification for recognition. A key for assistance in recognizing them might take the following form:

1. Chlorophyll cells of branch-leaves in section having form of equilateral triangle with fringe-fibrils.....(*S. imbricatum*)  
   Chlorophyll cells of branch-leaves having form of isosceles triangle with narrow base.....2  
   Chlorophyll cells of branch-leaves oval, central, enclosed.....3  
   Chlorophyll cells of branch-leaves exposed on both surfaces.....5
2. Pores on dorsal surface of branch-leaves oval-elliptical, not strongly ringed.....*S. palustre*  
   Pores on dorsal surface of branch-leaves numerous, small and strongly ringed.....*S. negrense*
3. Inner walls of empty cells of branch-leaves where overlying chlorophyll cells irregularly roughened.....*S. alegrense*  
   Inner walls of empty cells of branch-leaves where overlying chlorophyll cells smooth.....4
4. Pores on dorsal surface of branch-leaves oval-elliptical, not strongly ringed.....*S. magellanicum*  
   Pores on dorsal surface of branch-leaves small, strongly ringed.....*S. submedium*
5. Inner walls of empty cells of branch-leaves where overlying chlorophyll cells papillose.....*S. papillosum*  
   Inner walls of empty cells of branch-leaves where overlying chlorophyll cells smooth.....*S. erythrocalyx*

ITHACA, N. Y.



## A GUM ARABIC MOUNTING MEDIUM

GENEVA SAYRE

Glycerin mounting media for mosses have certain conspicuous disadvantages. Unless used with balsam and two covers<sup>1</sup> or ringed, the mounts are never really permanent, and in spite of these precautions most of my glycerin mounts are somewhat dilapidated. Another troublesome feature is that the specimens must remain in glycerin for a week or two before the slides can be made up. A better medium would be one which could be used directly from water, and would set hard quickly. For several years I experimented with various sugar media, but sooner or later they had a tendency either to fade the specimens or to crystallize. An exception was Brun's glucose medium,<sup>2</sup> which, when made up with glucose syrup, was partially successful. Certain mosses, as *Tortula*, persistently curled up in the medium.

The gum medium which I am now using is apparently satisfactory, and slides kept over a year are unchanged. Specimens are soaked in water, the leaves stripped and placed directly in a drop of the medium on a slide. In twenty-four hours at room temperature the slides are dry enough to put away. To make it up, take:

Gum arabic . . . . .	20 g.
Distilled water . . . . .	60 cc.

Let stand covered for several hours, then filter through coarse paper. Add:

Glycerin . . . . .	10 cc.
Formalin . . . . .	4 cc.

The amount of glycerin necessary appears to depend upon the climate. With 8 cc. of glycerin, the mount becomes too hard and checks around the edges. Twelve cc. seems the proper amount in the dry climate of Colorado. In the Hudson valley I find that a smaller quantity is sufficient. The medium may be kept conveniently in a bottle with a pipette stopper.

I have used the medium also for making permanent mounts of aceto-carmine chromosome smears, and for various small objects mounted for "practical" laboratory examinations.

RUSSELL SAGE COLLEGE, TROY, NEW YORK

<sup>1</sup> Conard, H. S. 1933. Mounting mosses with two cover slips. *THE BRYOLOGIST* 36: 2-3.

<sup>2</sup> Lee, A. B. 1937. *Microtomist's Vade-Mecum*. 10th Ed. Par. 465.

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New scientific names are printed in bold-face type

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